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AUTHOR'S EDITION  
FROM THE ANNUAL REPORT ON THE EXPERIMENTAL FARMS FOR THE YEAR 1897

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CANADA

DEPARTMENT OF AGRICULTURE

CENTRAL EXPERIMENTAL FARM

REPORT OF THE ENTOMOLOGIST AND BOTANIST

(JAMES FLETCHER, LL.D., F.R.S.C., F.L.S.)

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# REPORT

OF THE

## ENTOMOLOGIST AND BOTANIST

(JAMES FLETCHER, LL.D., F.R.S.C., F.L.S.)

DR. W. SAUNDERS,  
Director, Dominion Experimental Farms,  
Ottawa.

SIR,—I have the honour to hand you herewith a report on some of the most important subjects which have been brought officially under my notice during the past season.

Many other subjects which have required attention have already been treated of at sufficient length for present purposes in former reports of the Division, or are as yet incomplete. The correspondence during the year has been large and of a varied character. There were 1,920 letters received and 2,110 sent out. During the past year I have had several opportunities of attending meetings in different parts of Canada, and of studying in the field some of the important problems connected with the protection of crops from their insect and fungous enemies.

The experiments with grasses and fodder plants, native and exotic, have been continued and have proved of great interest to visitors. This part of the work of the division is in the charge of Mr. Berthold Nothnagel, who has shown great interest in his work and is untiring in his efforts to explain to all comers the value and nature of the experiments which are being carried on.

The Awnless Brome Grass having proved to be very successful in all parts of the Dominion, about 600 1-pound samples were last spring sent out to farmers in all the provinces. Such reports as have been received up to the present are, almost without exception, enthusiastic in their praises of this valuable grass. A special interest has been added to it lately by the discovery that it is particularly well suited for cultivation on alkaline patches where little else will grow.

During the year several thousands of specimens of plants and insects have been sent in for identification from naturalists in all parts of the Dominion. From these collections several valuable additions have been made to the Experimental Farm museum.

*Meetings.*—Whenever official duties would permit of my absence, every opportunity has been taken of attending farmers' meetings to meet farmers and to deliver addresses on the work of the Division.

In January last I attended the convention of the Eastern Dairymen's Association at Brockville, Ont., from 6th to 8th of January. The following week I went to St. Mary's, Ont., and was present at the convention of the Creameries Association, 14th to 16th of January. From 20th of January to February 2nd I was in Nova Scotia and New Brunswick, attending meetings of farmers and fruit growers. The annual meeting of the Fruit Growers' Association of Nova Scotia was held at Wolfville on 20th and 21st of January. The annual meeting of the Nova Scotia Farmers' Association was attended at Middleton on 26th, 27th and 28th. On my way back to Ottawa I stayed off at Sussex,

in New Brunswick, and held meetings with Mr. W. W. Hubbard at Hampton, N. B., on 29th of January, and at Sussex, N. B., on the following day. In passing through St. John, N. B., I met the members of the New Brunswick Natural History Society, and examined their museum on Monday, 1st of February. On 2nd and 3rd of March I was present at the annual meeting of the District of Bedford Dairymen's Association, at Cowansville, Que. On 3rd of June, by instruction of the Honourable the Minister of Agriculture, I went to Ste. Thérèse, Que., to examine some "drowned lands," representative of hundreds of acres along the Ottawa River, and to advise what grasses could be most advantageously grown on land liable to be under water during the spring freshet for two or three weeks. Some experiments are being tried and will be reported on later. The next day I started for St. Catharines and met a number of leading fruit growers, with whom I visited the orchard and beautiful grounds of Mr. Charles Thonger, near Niagara, where, unfortunately, the San José Scale has been introduced. I was commissioned by the Honourable Minister to meet these gentlemen and learn from them what their views were as to proposed measures asked for by fruit growers to prevent the spread of the San José Scale. The following morning I was driven by Mr. A. M. Smith to St. David's, to examine an orchard of Mr. Hendershott's, in which the San José Scale was said to occur. This report proved to be inaccurate, the insect in Mr. Hendershott's orchard being the Cherry Scale, *Aspidiotus Forbesi*, Jnsn., a less injurious species. Mr. Smith's nursery was also examined and no trace of the San José Scale was found.

On the following Monday, 14th of June, I left for Nova Scotia, where some meetings had been arranged by the Board of Trade of Kentville, and by the Fruit Growers' Association of Nova Scotia. Meetings were held at Kentville, Berwick and Auburn. The first meeting was largely of townspeople, but there were also several farmers and gardeners present who had been brought together by Mr. M. G. DeWolfe, the energetic President of the Board of Trade. The next day I was driven to Wolfville and had the pleasure of being shown over the School of Horticulture by Prof. Faville. The same afternoon, through the kindness of Mr. Barclay Webster, I was driven from Kentville through the luxuriant orchards of King's county to Berwick, where a good meeting had been convened by Mr. S. C. Parker, the Secretary of the Fruit Growers' Association of Nova Scotia. The morning of the 18th was devoted to examining the well-kept orchards of Mr. Parker and others at Berwick. In the afternoon I proceeded to Auburn, where I was met by Mr. J. S. Bishop, and driven through the surrounding country, visiting the cranberry bogs which have been so successfully worked for the last few years. In the evening a well attended meeting of cranberry growers was addressed and Cranberry insects were discussed. The next day I returned to Kentville and then went on to Halifax to attend the meeting of the Royal Society of Canada. I left Halifax for home on 23rd of June. On 3rd of July I proceeded to Manitoba by instruction of the Hon. Minister of Agriculture and at the request of the Manitoba Government. In company with Mr. Hugh McKellar, the Deputy Minister of Agriculture, I held a series of meetings in some of the important wheat growing districts of the province. Meetings were held at Neepawa, Gladstone, Dauphin, Glenlyon on the Gilbert Plains, Portage la Prairie. Brandon, Beresford, Blythefield and Glenboro'. The subject treated of at all these meetings was "Noxious weeds, their nature and habits and the best means to adopt for their eradication." We were accompanied at some of these meetings by the Rev. W. A. Burman, Mr. George Greig, of Winnipeg, and Mr. J. B. Hobson, of Guelph, who all took an active and useful part in the meetings. I returned to Ottawa again on 22nd of July. On 12th and 13th of October, I attended the annual meeting of the Entomological Society of Ontario at London, Ontario.

*Acknowledgments.*—As in previous years, I am under great obligations to my friends, Prof. John Macoun and Mr. W. H. Harrington, both of Ottawa, for frequent assistance in the identification of difficult plants and insects. I also take pleasure in again acknowledging the valuable assistance I have received from my many correspondents in all parts of the Dominion, who have much aided the work of the Division by making observations and by sending me prompt notice of the occurrence of injurious insects and weeds. My thanks are also particularly due to Dr. L. O. Howard, the

United States Entomologist, and his staff at Washington, as well as to Dr. C. H. Fernald, of Amherst, Massachusetts, and Lord Walsingham, F.R.S., of Merton Hall, Thetford, England, for many favours in identifying insects and for valuable publications.

I again thank my kind friend, Miss E. A. Ormerod, for her most useful publications and valuable advice. On the occasion of a short visit to England in August last I had the great pleasure of again calling on this energetic worker and of learning from her many things of great use to me in my official duties.

The following donations have been received during the year :

Prof. J. Lamson Scribner, Washington : A large collection of seeds of grasses and fodder plants.

M. G. DeWolfe, Esq., Kentville, N. S. : Several living roots of greenhouse plants, bulbs and perennials.

T. W. Ramm, Esq., Bewdley, Ont. : Insects.

Rev. G. W. Taylor, Gabriola Island, B. C. : British Columbia plants and insects.

T. N. Willing, Esq., Olds, Alta. : Rare plants and insects from Alberta.

In conclusion, I beg again to acknowledge the great help I receive continuously in all branches of the work of the division from my assistant, Mr. J. A. Guignard, B.A., who has done much by his assiduous attention to bring the Division of Entomology and Botany to such degree of efficiency as it has attained.

I have the honour to be, sir,  
Your obedient servant,

JAMES FLETCHER,  
*Entomologist and Botanist.*

## CEREALS.

The large wheat crop of the Dominion was got in for the most part in good condition. In some sections of Ontario late rains were a cause of loss, from the grain sprouting in the field. There was no serious damage from injurious insects in any of the provinces, although in Manitoba some loss resulted from an unknown cause, by which many ears of wheat turned white before the grain was mature and the stems remained standing in the field; this injury was spoken of generally as "dead heads" and was in places of much importance. It was thought by some to be due to the attacks of a fungus, but other observers spoke positively of finding insects which were actually attacking the roots. From the information given by correspondents, I judge that this was not the work of the Wheat-stem Saw-fly (*Cephus pygmaeus*, L.) treated of in my last report but of a dipterous larva. During the past summer the perfect flies of *Cephus pygmaeus* were reared from straws sent from Souris, Man., by Mr. Wenman, thus proving without doubt the identity of the species which injured Mr. Wenman's wheat last year. During the past summer some harm was done by the same insect near Indian Head, N.W.T.

With regard to the "dead heads," Mr. A. C. Hawkins, of Swan Lake, Man., writes—and his opinion seems well supported:—"I still think that the 'fungous disease' is an after effect and not the cause of the death of the wheat plant, the cause being, in my opinion, the larva forwarded in my last letter which you could not find, but of which, at the time that it was collected, I had no difficulty in finding many more than I wanted, one or two in the root of every plant I examined of which the heads were just beginning to dry up."

Mr. A. W. Pritchard, of the Manitoba Department of Agriculture, writes:—"Numerous reports have been received by the Department, of damage done to the wheat crop by an insect which is commonly spoken of as attacking the root, though some of our reporters call it a 'Joint-borer.' The effect of its attack is everywhere the same, to cause the plant to turn white and produce an empty head. The ravages of this insect, if insect it be, have extended over a large area. The damage done is reported in some cases as much as one-half the crop."

Arrangements have been made to study this attack more fully next year, and specimens of injured stems will be thankfully received.

The JOINT-WORM (*Isosoma*).—An attack on wheat by a joint-worm is reported from Verdun, Bruce Co., Ont., by Mr. William Welsh, who has studied the matter with some care. He writes as follows:—

"July 28.—The year before last was the first when I noticed this new pest; it was detected in the broken straw at threshing time, the larvæ of the insect being easily seen by splitting the hard pieces of broken straw with a sharp knife. Last fall there was much more of the broken straw in the threshed grain. It seems almost impossible to get these pieces out with the fanning mill, and consequently many larvæ are sown with the fall wheat. I think this insect must have had much to do with the injured grain of last fall. On looking in the bins of wheat at mills or elevators, I became convinced that this insect is worthy of full inquiry and that it is rapidly spreading here.

"November 25.—Since corresponding with you I have felt much interest in this subject, and have made special observations and inquiries concerning the joint-worm. I send you by this mail specimens of infested straws which I have picked from the fall wheat stubble. The piece of ground where I had my fall wheat having been seeded to clover gave me a chance of getting some specimens nearly as good as those I sent before harvest. I also inclose some samples of the broken straw as found in threshed wheat. You will find that these short pieces are hard and woody from the action of the insect upon the growing stem. The pupæ are still alive and ready in the warm days of spring to eat their way out and go through the same routine as their parents before them. In

some of the pieces of straw, a little over an inch in length, there may be found from five to ten insects. A bushel of such straw lying loose about a barn would give enough insects to destroy many fields before the grain ripened. I think you will agree with me that every farmer should see that the cleanings from the fanning mill are either fed or burned to destroy the insect."

*Remedies.*—As stated by Mr. Welsh, the broken hardened pieces of straw noticed when threshing and cleaning grain should be collected and burned. The grain should also be examined for these pieces which should be picked out by hand.

Most of the galls or hardened sections of stem in which the insect passes the winter are low down near the root. The burning of stubbles and deep ploughing are therefore useful in destroying large numbers of the pupæ. The term "joint-worm" probably covers more than one species of minute hymenoptera which attack the stems of wheat and barley; but, fortunately, the attack is of rare occurrence in Canada, and there have been few opportunities of examining the mature insects.

Young plants of fall wheat sent by Mr. Welsh from Verdun in November were found to be attacked by both HESSIAN FLY and the WHEAT-STEM MAGGOT. These two pests were also somewhat abundant in Prince Edward Island. Mr. Edward Wyatt, writing from Pleasant Grove, P.E.I., September 18, says:—"The FRIT FLY for many years now has been doing considerable harm to our wheat and hay crops. The Hessian Fly I have no doubt is the principal aggressor, but the Frit Fly and Wheat-stem Maggot have been associated with it. Some of the maggots which infest the straw are of a yellowish colour, others are green. These pests have been on the island continuously for the last 17 years. The damage was slight until the last three or four years. Many who sow early have poor crops and with no knowledge of the cause. We all sow now from May 20 to 24, thus escaping the first attack which, if bad, ruins the crop. We have never grown better wheat crops than in the past two years—that is, generally; fully one-third of my wheat this year fell down two weeks before it was ripe, still the crop was a fairly good one; but should the season prove favourable to these pests, the damage might be serious."

**THE GRAIN PLANT-LOUSE** (*Siphonophora avenæ*, Fab.)—Specimens of wheat and oats attacked by the Grain Plant-louse have been sent in from several localities. The worst attacks were reported by Mr. John Tolmie, of Cloverdale, Victoria, B.C., on oats and by Mr. Lewis Rogers, of Cooksville, Peel Co., Ont., on fall wheat, where much damage was done to the young plants in October and early in November. In a case of this kind, if the vigorous wheat plants which have passed the winter are found to be too few in spring for a paying crop, clover may be broadcasted over the land before rolling, or the crop may be helped with a top dressing of some special fertilizer.

**GRASSHOPPERS.**—A noticeable feature of the correspondence of the division during the past season, as compared with last year, was the almost total absence of complaints of injury to farm crops by grasshoppers. This state of affairs was anticipated on account of the abundance of parasites of several kinds noticed last year and mentioned in my report for 1896.

Fig. 1. The Red-legged Locust. Hair-worms (*Gordius*) have been sent in from Ontario and Quebec more frequently than any other parasites. The account of the strange life-history as far as known, never fails to excite the interest of inquirers. The only localities from which grasshoppers have been mentioned as injurious are: Sable Island, N.S., where they destroyed Brome grass which was being experimented with as a sand binder; Manitoulin Island, Ont., where they did much harm to turnips; and parts of Peterborough County, Ont., where hay and oats suffered to a limited extent from their ravages.



## THE PEA WEEVIL OR "PEA BUG"

(Bruchus pisi, L.).



Fig. 2.—The Pea Weevil—natural size and enlarged until full-grown, consuming the interior of the pea and passing through all its stages from a white fleshy grub to the chrysalis and then to the perfect beetle. Some of the beetles, the percentage varying with the season, escape from the pease in the autumn and pass the winter hidden away under rubbish or about barns and other buildings. The greater number, however, do not leave the pease until the following spring, so that they are frequently sown with the seed.

The perfect insects fly easily and resort to the pea fields about the time the blossoms appear. They have been observed feeding upon the leaves and flowers of the pea vines before the pods were formed, but the injury so done is inappreciable compared with the much greater loss from the injury to the seeds by the grubs.

From the large numbers of beetles which I once found dead, after a severe winter, beneath the shingles of a barn, I am led to believe that, in those seasons when a large percentage of the beetles issue in the autumn, many are apt to be destroyed by severe cold.

Frequent inquiries come in every year for information concerning the Pea Weevil and the best means of preventing its injuries.

During the past season, from such reports as have been received, it would appear that on the whole the Pea Weevil has not been quite so injurious as in former years. Some correspondents, however, report that the injury is still considerable.

"Picton, Prince Edward Co., Nov. 6.—Our big pea houses report that the Weevil this year was not as bad as usual. Every effort is now made to destroy the Weevil by what is called "bugging" the pease as soon as they are received from the farmers."—[Wellington Boulter.]

The insect itself and its life history are now well known in the districts where it occurs; and, if more care were taken to sow only uninfested pease or those which have been properly fumigated, there would be no difficulty in reducing very considerably the numbers of this pest, which every year affects so materially the value of the pea crop of the Dominion. There are vast areas in Canada where good seed pease can be grown as a paying crop, and where the Pea Weevil does not occur at all. The advantage of obtaining seed from these districts is obvious and has already been recognized by some of the large seed firms. In addition to this, the method usually adopted of killing the weevils, either as grubs or as perfect beetles inside the seed pease, by subjecting them to the fumes of bi-sulphide of carbon, is perfectly effective. Most of the seed houses at the present time treat their seed carefully and conscientiously, and the injury to the crop is now done chiefly by grubs from eggs laid by weevils which have either left the pease in the autumn and wintered over, or else from pease saved for seed in small quantities by farmers who took no steps to destroy the weevil before sowing time.

Writing early in the present season, Mr. T. G. Raynor, of Rose Hall, Prince Edward Co., Ont., says:—"I do not think the pea weevil was nearly as bad in this county in 1896 as in previous years. Perhaps the season had something to do with it.

*Attack*.—A small, brownish gray, very active beetle,  $\frac{1}{5}$  of an inch long, with two conspicuous black spots on the end of the body, which emerges from seed pease in autumn or in spring, leaving a small round hole. This insect is generally spoken of under the incorrect name of "pea bug," and infested pease, as "buggy" pease. The egg is laid on the outside of the young pod, and the grub, on hatching, eats its way in and penetrates the nearest pea. Here it remains

Still, every year for some time past, there have been fewer pease owned and sowed by the farmers themselves. The company pease, which are treated for the bug, have replaced the others. This must necessarily have its effect for good. I have no doubt that the pease had more bugs in them than was generally supposed, as the fancy pease grown here are cut and marketed early, before the weevil has developed much or can be detected, and the pease are generally treated for the bugs as soon as they are marketed."

Late sowing is sometimes recommended as a preventive remedy, but is more or less uncertain in its good effects according to the season, and has never become very popular, although the method has always a few adherents in all districts visited, the idea, of course, being to delay the development of the pease until after the season when the weevils lay their eggs. The chief danger is that late sown pease are apt to be attacked by the ordinary white mildew of the pea, which reduces considerably the crop.

I quote from my annual report for 1890, a statement by Mr. J. H. Allan, of Picton, Ont., one of the best informed authorities in the pea trade:—"Many of our farmers sow the late sorts of pease late in the season—say, the first part of June—with good results. I have seen a field of Golden Vine pease sown early in May. The crop was literally filled with bugs. The neighbour of this farmer planted his in June, and his crop had none. I would say, plant as late as possible; but this will not answer for all kinds. The extra early varieties must be put in as early as possible to insure a paying crop."—(*Report of Ent. and Bot., C. E. F. Report, 1890*, p. 173.)

"Weston, York Co., Ont., March 8:—The pea weevil, which eats out the centre of the pease in the barn, around here destroys about one-quarter of the crop. Some people sow late to escape the weevil, but they do not get half the crop as when they sow early. To sum up, if you sow early, you get a good crop of pease and weevil. Sow late, you get a poor crop of pease and few weevils. We sow about forty acres of pease on our 250 acre farm."—[J. La F. Stonehouse.]

*Remedies.*—Bisulphide of Carbon.—Where the crop is large, undoubtedly the wisest course to adopt in districts where the pea weevil occurs, is to fumigate the pease with bisulphide of carbon as a regular practice as soon as possible after harvesting. In this way, any weevils contained in the pease will be destroyed in the grub state before they have consumed much of the substance of the pease in which they are undergoing their transformations. This may be done by placing the infested seed, according to the quantity to be treated, in some suitable receptacle, as a tight barrel, box or bin, or, if the quantity is large, in a specially prepared building. Mr. Allan describes his method, which is practically that generally adopted, as follows: "Nearly every large grower has a building for the purpose. If properly made, it works well. The whole building must be very tight to be of any use. Some use tin, others cement and paint and paper lining, with a double floor and tarred paper between. The pan we use to put the carbon bisulphide in is about three feet across and only about four inches deep. The chemical is thus exposed to more air than it would be in a deep dish, from which it could not evaporate quickly enough to do good service. I put my pan up close to the ceiling above the pease, because the vapour, being so much heavier than air, works down through them. We fill the building with bags as close as possible up to where the pan hangs, empty the bisulphide into the pan and get out as quickly as possible, close the door up tightly and leave it for 48 hours. This must be done in warm weather, as the liquid does not vaporize well when the temperature is lower than 10 degrees above zero." (*C. E. F. Report, 1890, loc. cit.*)

Perhaps the most convenient receptacle for treating weevilly pease, for farmers, is an ordinary 45 gallon coal oil barrel, into which 5 bushels of pease may be put at a time; the quantity of bisulphide of carbon which has been found necessary is one ounce to every hundred pounds of seed; therefore, for the above quantity three ounces should be poured into some flat pan placed on the top of the seed or sprinkled over the surface, and the barrel covered closely, first with a thick cloth or canvas which has been damped in water, and then with boards. The barrel should be in an outside shed and left closed for 48 hours.

Bisulphide of carbon is a colourless liquid which volatilizes very readily at ordinary temperatures; the vapour, which is quite invisible but has a strong unpleasant

odour, is heavier than air, and therefore sinks readily to the bottom and permeates the whole contents of any closed receptacle in which it is used to free grain of infesting insects.

Great care must be taken in the use of this chemical on account of the extreme inflammability both of the liquid and its vapour. No fire, such as a flame or even a lighted pipe or cigar, must be taken near either the liquid or the bin in which the pease have been treated, for some time after it is opened and the heavy and inflammable vapour has been let out. Treating seed of any kind with bisulphide of carbon has no deleterious effect upon the vitality of the seed nor upon its wholesomeness as food.

The question sometimes arises whether pease badly infested with weevils can be used safely for feed. I find upon inquiry that it is a general practice to grind up weevilly pease and use them for feed, and no injury to stock has been reported so far. Mr. T. G. Raynor, answering this very question in the *Farmer's Advocate* for March 1, 1897, says:—"The culled pease from re-cleaning the pease at the seed houses, after being treated for the bug, are used for feeding purposes, and I have not heard of any injury." Mr. Wellington Boulter, the Mayor of Picton, Ont., one of the most important centres of the seed-pea trade in Canada, also writes as follows:—"November 26.—In re your inquiry as to grinding pease infested with pea-weevil for pigs, injury to stock, &c., I would most emphatically say no injury could happen. I have ground up quantities in the past. I have also fed pigs with the pease in the natural state and never heard of any injury. In grinding, the bugs would be ground to powder."

Holding over seed.—Some people may not care to have such a dangerous material as bisulphide of carbon about their premises. For such, an excellent remedy is holding over until the second year after harvesting any pease required for seed. This may be done in the case of pease without any injury to their vitality. They should be inclosed in paper or cotton bags, which will be sufficient to prevent the beetles from escaping when they emerge. At the time of sowing the pease, they should be examined and if necessary hand-picked; every grain which has been perforated should be discarded, as frequent experiments have proved that it is impossible to grow strong plants from weevilled pease, although unfortunately there is a widespread belief to the contrary.

The PEA MOTH (*Semasia nigricana*, Steph.).—This enemy of the pea, which has



Fig. 3.—The Pea Moth—natural size and enlarged. It is probably identical with *pisana*, Guen., and has long been placed under the genus *Semasia*, but Meyrick in his *Handbook of British Lepidoptera* puts it under the genus *Laspeyresia*, Hbn.

The accompanying figure has been kindly supplied for this report by Messrs. Blackie & Son, of Glasgow, Scotland. It is by John Curtis, and was used in his great work "Farm Insects."

Six specimens of the moth were bred, and all emerged between the 12th and 15th of July. As the cocoons were kept under natural conditions this is probably the time when the moths appear in nature, which would emphasize the value of the remedy already suggested of early sowing. The moth is small and inconspicuous,  $\frac{1}{4}$  of an inch long when the wings are closed, mouse-coloured, bronzed towards the tips of the wings, silvery gray beneath. The only markings are along the front margin or costa and near the apex of the upper wing. The costal marks consist of about 10 or 12 short black triangular streaks, separated from each other by similar clear white dashes all directed backwards; two of the black streaks, however, the third and fifth, which start from

about the middle of the costa, are much longer than the others and run parallel to each other diagonally one-quarter across the wing towards the apex; these are narrowly margined with bronze scales and broadly shadowed on the side towards the apex with bands of pearly gray scales. These bands run right across the wing and unite at the other margin, thus inclosing a somewhat oval or flask-shaped space, which bears in its centre 4 or 5 short longitudinal dashes and also includes in its neck the outer of the two long black diagonal streaks from the costa.

The injury from the caterpillars of the Pea Moth was not so marked in Ontario and Quebec as in previous years, but in the Maritime Provinces it has been as wide-spread as usual. Mr. J. E. Wetmore, of Clifton, King's Co., N. B., sent me on 16th of September last several pods of Stratagem and Crown peas, also of the wild Tufted Vetch, *Vicia Cracca*, with the following notes: "I find that they attack the Stratagems in all stages of growth, from the most immature to those nearly ripe. I have found but few in the green Crown pease. In this variety they are almost always among the ripe ones. Nearly every pod of Stratagem is affected, while but about one-third or one-quarter of the Crown pease are attacked. Early pease ripening in July are not liable to be attacked, but, as the season advances, their numbers increase till the tender late varieties are almost wholly destroyed. I have examined some pods to see where the attack generally occurs. I thought it was always at the upper end, but of fourteen specimens before me three are attacked at the upper end and three at the lower end, while eight are at intermediate points, so that there does not seem to be any regular spot for the egg to be laid and the young caterpillar to enter the pod."

"Berwick, King's Co., N. S., 26th November.—The Pea Moth has been very destructive to both garden and field pease."—[S. C. Parker.]

## ROOT CROPS AND VEGETABLES.

Garden vegetables and root crops during the past season have been little attacked by insect pests.

CUTWORMS.—There have been the usual local occurrences of cutworms in different parts of the Dominion; but, with the exception of a severe outbreak on Vancouver Island, there was no widespread devastation complained of. No mention of cutworms was made in the provincial crop reports of Ontario, Nova Scotia, or Manitoba. Rev. Father Burke reports from Prince Edward Island: "Cutworms seem to dislike a wet season, like some other insects. We were relieved very much in this respect last spring."

"Yarmouth, N.S.—Cutworms were not as destructive as usual."—[C. E. Brown.]

"Clifton, King's Co., N.B.—Last season cutworms were very destructive here, so that it was almost impossible to raise any vegetables; this year there have been very few losses from them. 1896 was very dry; this season, 1897, has been moist and cool; would this account for the difference in their numbers?"—[J. E. Wetmore.]

"Victoria, B.C., Nov. 8.—Cutworms were numerous and destructive this spring and destroyed quantities of young garden stuff."—[R. M. Palmer.]

"Thetis Island, B.C., June 3.—I send specimens of an insect which is working havoc to the root crops here; my onions are all gone, and beets and carrots are slowly disappearing; it cuts off the young plants close by the ground."—[Peter Hunter.]

"Mattawa, Nipissing, Ont., June 21.—Inclosed find grubs which are working great havoc in crops attacking almost everything in the shape of vegetables, particularly beans, corn and cabbage."—[C. G. Hurdman.]

"Stonefield, Argenteuil Co., Que., June 25.—The farmers in this neighbourhood, who have sown feed corn, are troubled to a serious extent by a grub, which cuts off the young plant as soon as it appears above the ground."—[Reuben Wilden.]

"St. Patrick, Temiscouata Co., Que., June 26.—All the gardens in this neighbourhood are suffering from the depredations of a grub, which is devouring all the young

vegetables. It is a common grub, but is in such unusual numbers that the poor people fear that every vegetable will be destroyed."—[Mrs. D. W. Macdonell.]

No new remedies have been discovered for these troublesome pests of the garden and farm. The remedies given in my last report have been found very serviceable, particularly the poisoned bran remedy, when the material was used either dry or moistened.

Potatoes have been an uneven crop, very good in many places, but in as many others, there was loss from neglecting to use Paris green for the Colorado Potato-beetle and to spray for the potato-rot. Mr. W. W. Hubbard, of Sussex, N.B., the editor of the *Cooperative Farmer*, says:—"We had a very wet spring with considerable damp, sultry weather through the summer, and this was very favourable to spore growth. Potatoes were early struck with rust. Scarcely any one will use the Bordeaux mixture." This is a great pity, for the results of spraying to prevent the potato-rust, which later produces the potato-rot, are so marked that any one who will try a small experiment, must be soon convinced of the value of this remedy.

**BLISTER-BEETLES.**—The Black Blister Beetle (*Epicauta Pennsylvanica*, DeG.) appeared in large numbers at St. Denis, Kamouraska Co., Que., on potatoes. Several specimens were sent by Mr. J. C. Chapais. The Gray Blister-beetles (*Macrobasis unicolor*, Kirby) did much harm to potatoes and beans at South River, Muskoka, Ont., and Mr. J. F. Sheil, having read in previous reports of the difficulties of some of my correspondents in treating these insects without injuring the crop, tried some experiments with the insecticide "Slug shot," which he prefers very much to the ordinary mixtures of Paris green used for this insect, finding it equally effective, with no danger of injuring the foliage of the plant treated.

**APHIDES** or plant-lice were very abundant last season, almost everything being attacked severely. No specimens were received, but several correspondents refer to injury to carrots by a species of plant-louse which spotted the foliage and stunted the roots of the carrots. This occurred in Ontario, Quebec and Nova Scotia. Mr. C. E. Brown, of Yarmouth, N.S., reports:—"Among hardy vegetable crops there was injury and in some cases there was a total loss of carrots from the attacks of aphides. These pests were prevalent not only throughout this county, but in the adjoining counties."

**THE CARROT RUST-FLY** (*Psila rosae*, Fab.).—*Attack.*—Early in the season the leaves of young carrots turn reddish and the roots will be found to be blotched with rusty patches, particularly towards the tip. These carrots when stored for winter use,

although sometimes not showing much injury on the outside, may be found to be perforated in every direction by dirty brown burrows, in which are many semi-transparent yellowish maggots about  $\frac{1}{2}$  of an inch long. These maggots are blunt at the tail end, but taper toward the head, where is a black hooked tip, forked at the base, by which the maggot makes its way through the roots. The puparium is reddish-brown, and the maggots, as a rule, leave the carrots before assuming this form.

The fly and its work are shown very well

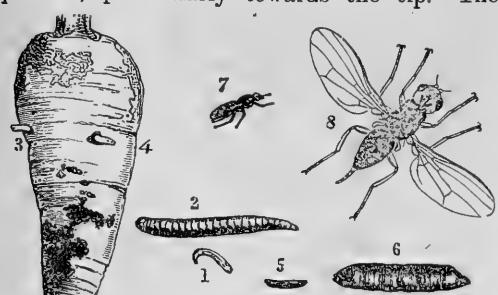


Fig. 4.—The Carrot Rust-fly—natural size (1, 5, 7), and enlarged (2, 6, 8.)

in the figure (Fig. 4) by John Curtis, which I am able to present herewith through the courtesy of Miss Ormerod and Messrs. Blackie & Son. The mature fly is two-winged,  $\frac{1}{2}$  of an inch long, bright shiny black, with yellow legs and red eyes. The wings are beautifully iridescent. The winter is passed either as a maggot or in the puparium. Miss Ormerod, the eminent English entomologist, who has studied the insect for many years, describes the attack as follows:

"The method of life of the Carrot Fly is to go down into the ground, where she can find a chink or cranny by the carrots. There she lays her eggs on or by the roots,

and the little yellowish or whitish maggots which hatch from these work their way into the root itself, or, if this is still very small, often destroy the lowest part. When full fed they leave the carrots and turn to the chrysalis state in the ground. The chrysalis cases are cylindrical and of a rusty or ochreous colour, and from these (in summer) the little blackish-green, two-winged flies, with rusty, ochre-coloured heads, come out in about three or four weeks." (E. A. Ormerod. *Ann. Rpt.*, 1898, p. 11.)

During the last ten or twelve years occasional complaints have been received of injuries to carrots by the larvae of the Carrot Rust-fly. These have been mostly from the province of New Brunswick, but also once or twice from Ontario and Quebec. This attack is a serious one, the carrots stored for winter use being rendered useless for the table from the discoloured burrows of the numerous maggots which sometimes occur in a single root. In 1895, Mr. J. S. Armstrong, of Rothesay, King's County, N.B., who had suffered severely from the ravages of this insect, noticed that late sown carrots were less injured than those sown at the ordinary time. This practice has since been recommended, and has been adopted with considerable success.

"Upper Sackville, Westmoreland Co., N.B., March 4, 1896.—My son William has written me that he was talking to you about the carrots we grew in our garden the past two years. He wished me to send you a sample; but they were so badly affected in the fall that we fed them to the cattle. I send you 2 small roots I found in the cellar. They will show the disease, but they do not represent the growth, as they are too small. The crop was large enough, but I think every carrot was diseased. It was in 1894 that we first noticed that something was wrong. In 1895 I planted in another place, but they were no better. Carrots had been grown on the same land previous to 1894 and were sound and good."—[John Fawcett.]

"Brookville, St. John Co., N.B., Dec. 20, 1896.—I send you carrots badly infested by some maggot which entirely destroys them, burrowing in every direction through the root. The carrots came up well, but after I weeded and thinned them they began to wither down in spots. The remainder seemed to grow pretty large, but when pulled were all full of maggots and are not fit for use."

"Feb. 15.—In reply to your letter, I sowed my carrots the first week in May. I have made inquiries of some of the farmers here and find that those who sowed later had their carrots not nearly so badly attacked as mine. Do you think cropping the same ground year after year would affect the roots?"—[Benjamin Hevenor.]

"Upper Sackville, Westmoreland Co., N.B., Jan. 5, 1897.—I sowed a much larger patch of carrots on another part of my farm later in May and had an excellent crop. No appearance of the maggot; but last year ours were so bad that we had to buy for table use. The man we bought of lives some eight miles from here. This year his carrots are affected, to all appearances as ours have been. I know of no other cases. He has been growing carrots on the same plot for some time."

"Dec. 15.—We have had no trouble with carrot-fly this year since we changed the place of cultivation. I have heard of another attack, however, on a friend's place ten miles distant. I will send you some infested roots as soon as I can get them."—[W. W. Fawcett.]

"Clifton, King's Co., N. B., Sept. 16.—I find it almost impossible of late years to get a crop of carrots on account of a small white grub which attacks the roots from the time they are very young and continues its ravages throughout the season."

"Dec. 10.—In reply to your favour inquiring about injury to my carrots this year. Last year they attacked the carrots severely. I did not harvest more than one-third of a crop. This year they attacked the young plants and cut them down very badly in my field, and in disgust I ploughed them under and sowed late turnips. From appearances, had I left them, I would not have had more than one sixth of a crop, if any at all. One of my neighbours had about one-third of a crop, and another still less. There are very few carrots raised here of late years, on account of this pest."—[J. E. Wetmore.]

*Remedies.*—Where remedies have been applied by my correspondents, the best results have been secured by the use of ordinary coal oil, either in the form of sand saturated in the proportion of one half a pint of coal oil to three gallons of dry sand, ashes or land plaster, which was sown at short intervals along the row, or of kerosene

emulsion, one part of the ordinary Riley-Hubbard formula to 10 of water sprayed along the rows.

Miss Ormerod gives the following advice:—"For prevention of attack generally, what is needed is a well prepared soil which will push on good growth of the plant, and also not be liable to crack, and also such management of ground and plants at thinning-time as will not allow the Carrot Fly to get down to lay its eggs by the roots. *This point is the important matter in the prevention of the Carrot-grub attack, commonly known as 'rust.'* If the fly cannot get to the roots to lay her eggs, obviously there will be no maggots to harm them, and the reason why carrots which have done well up to thinning-time often fail afterwards, is because the ground is thrown open in the operation.

"I always advise that the greatest amount of thinning that can be managed should be done as early as possible, then give good waterings after thinning, and from time to time afterwards to drive the surface soil together."

From our Canadian experience it would appear that late sowing has a particularly good effect. When carrots are grown as a farm crop, it is, of course, well to sow them as early as convenient and thus secure as heavy a crop as possible; but, for table use, I have found by experiment that this vegetable may be sown very much later than is the usual practice, and, if frequently hoed or cultivated, will give a good crop of excellent roots, while at the same time the danger of loss from the Carrot Rust-fly will be much lessened. Carrots sown as late as the third week in June produced a crop of table carrots of good size and excellent quality.

Where this fly is known to be prevalent, carrots should be sown every year as far distant as possible from land which is known to have been infested. Where carrots are stored during the winter in sand or earth, this, of course, must be treated to destroy the pupae which leave the roots and enter the soil to pass their last preparatory stage. Miss Ormerod suggests that this earth might be put into a wet manure pit so as to prevent the hatching out of the flies. Should neither of these methods be convenient, at any rate, it might be buried in a deep hole dug in the ground for the purpose.

THE SPINACH CARRION-BEETLE (*Silpha bituberosa*, Lec.).—Attack.—Shiny black,

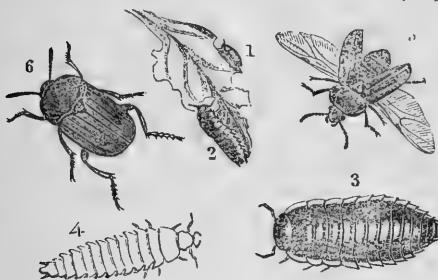


Fig. 5.—Carrion-beetle (5, 6); larvæ (1, 3, 4).

very active, flattened grubs  $\frac{3}{4}$  of an inch in length, shaped like wood-lice, which devour the leaves of plants belonging to the spinach or goosefoot family (*Chenopodiaceæ*) and also members of the Gourd family. In my Report as Entomologist for 1893 is given an account of injuries to crops by this carrion-beetle. During the past summer there was a new outbreak at Calgary, Alta. Mr. E. D. H. Wilkins writes:—"May 30.—A black grub is swarming in my garden this spring and devouring the leaves of the spinach and beet. I also find it on the weed commonly called lamb's

quarters. Please advise me as to a remedy, for this grub is doing a great deal of damage, and I do not like to use poison on the spinach leaves."

"June 13.—I sent you a few days ago some more grubs, as you wished. I have tried Paris green traps and used overgrown spinach plants. We have had only five hours' rain this year, so that it is a struggle to keep things going. There is very little succulent vegetation to use for traps such as you suggest. Your advice about keeping the place clean of all weeds is more to the point here. Last year I was careless and let lamb's quarters grow in great quantities in waste places in the garden. That is evidently why I am now plagued with these beetles. After trying the Paris green traps I counted twelve corpses in one row. I am satisfied that with these, as I have found it is the case with cutworms, the best preventive measure is to clean up everywhere and leave no weeds or lamb's quarters growing, so that the insects can have no chance to breed."

**Remedy.**—The only remedy which can be suggested for this insect when it attacks such plants as beetroots and mangels is to dust the young plants at the end of May and during the first part of June, when the grubs appear, with a poisonous mixture such as Paris green and some powdery diluent, *e.g.*, flour, land plaster or ashes, one part to 50. In the case of spinach, it may be necessary to cover the plants with netting or cheese cloth for a time; or a more attractive food plant such as lamb's quarters, or the native weed of the West, *Monolepis*, which is stated to be the favourite food plant of this insect, may be sown close to the spinach to draw off the attack.

## FRUITS.

The fruit crop of Canada for the year 1897, although in no way comparable for quantity with that of last year, has been, on the whole, a good crop, and where spraying has been adopted good profits have been made. It is to be regretted, however, that some of our less progressive fruit growers have not yet adopted this most useful means of saving money. This is in some measure due to the ignorance of fruit buyers, who, it seems, cannot be taught that there is not the slightest danger from the use of fruit from trees which have been sprayed, and that, if sufficient poison were used to make the practice dangerous, the fruit grower would be the first to suffer, because the amount of poison necessary for that would cause both leaves and fruit to fall from the trees long before the fruit was ripe.

It would take too much space to give extracts from letters of practical business men who have learnt from experience the value of the practice of spraying against injurious insects and fungous diseases; but hundreds might be cited.

Among fruit insects of the present season the San José Scale has been the subject of extensive correspondence; but many other insects which, except for the anxiety thus aroused, would not have attracted notice, have also been inquired about. Some of those species which may be called the standard pests of the orchard and fruit garden, have been less in evidence than usual. Next to the San José Scale, TENT CATERPILLARS called for most information, and occurred in injurious numbers both in orchards and upon forest trees. In the Ottawa district basswoods (*Tilia*) were much injured and groves of aspen (*Populus tremuloides*, Michx.) for many miles along the Ottawa River were stripped perfectly bare of foliage in the month of June. At Bewdley, Northumberland Co., Ont., Mr. T. W. Ramm, says:—"I never saw so many Tent Caterpillars as there were here this spring." Mr. Ramm also bred from the cocoons several specimens of the useful "ichneumon fly" *Pimpla pedalis*, Cress. Mr.

F. W. Payne sent specimens of the Forest Tent Caterpillar from Hall's Glen, Peterboro' Co., Ont.:—"July 17. As I drove along the road  $2\frac{1}{2}$  miles from here, I noticed that the maple trees were defoliated to the extent of  $\frac{1}{3}$  to  $\frac{2}{3}$  of their foliage, and hundreds of moths were flitting through the branches. The cocoons hung in the maples, by hundreds, one to each leaf with the edges drawn together by a web."

Tent Caterpillar injuries are also reported from the Annapolis Valley, Nova Scotia, by Mr. S. C. Parker, of Berwick, and Mr. M. G. DeWolfe, of Kentville, N.S.; and in Manitoba Mr. H. W. O. Boger found them unusually abundant at Brandon, attacking currant bushes, roses, choke cherries and the mountain ash.

Fig. 6.—Forest Tent Caterpillar. In British Columbia these insects swarmed on every hedge and also did much harm in orchards.

"Victoria, B.C., April 28.—Tent Caterpillars are hatching and are very numerous.—[R. M. Palmer.]



"Victoria, B.C., May 18.—Tent Caterpillars swarm everywhere, but as usual a large proportion bear the eggs of parasites (*Tachina*). I am sending you a specimen of the Caterpillar with no less than 8 eggs on it; from this you will see the abundance of the parasites."—[E. A. Carew-Gibson.]

The specimens represented in Mr. Carew-Gibson's sending were *Clisiocampa Californica* and *C. Americana*.

"Agassiz, B.C.—We have this year swarms of Forest Tent Caterpillars. The hazel, willow, crab apple, birch and alder in the woods, all seem to be infested."—[Thos. A. Sharpe.]

Fig. 6 shows the Forest Tent Caterpillar and Fig. 7 the eggs (natural size and enlarged) and female moth of the same. All the Tent Caterpillars resemble each other very much and will be easily recognized from these cuts.

The remedies for Tent Caterpillars of all kinds are hand-picking of the eggs and young colonies and the spraying of the foliage of infested trees before the caterpillars get large enough to do much harm.

CANKER-WORMS (*Anisopteryx*).—Two references only to injury by Canker-worms have been made this season; but I observed while travelling through Nova Scotia in June last the abundant presence of these insects in certain localities. I was much pleased to notice the general adoption of spraying by the leading fruit growers. These caterpillars must be treated while they are young, or the ordinary spraying mixtures are not strong enough to destroy them.

"Grimsby, May 31.—Mr. Laws has handed me a box of apple boughs cut from his father's orchard near Camden, Ont., where the Canker-worm is very bad. He says he has tried Paris green faithfully without effect. The orchard looks as if fire had been through it in summer."—[L. Woolverton.]

"Berwick, N.S.—The Canker-worm still crops up in some sections; an infected district takes a long time and careful work to clear up. I do not know of any serious losses this year from its ravages."—[S. C. Parker.]



SHOT-BORER (*Xyleborus dispar*, Fab.).—This injurious enemy of the apple continues to commit serious depredations in the orchards of Nova Scotia and Prince Edward Island, where it attacks both apple and plum trees. The most extensive injury brought to my notice during the past season occurred at Grand Pré, King's County, N.S., where Mr. George Johnson, the Dominion Statistician, found the beetles working much havoc in his own orchard as well as in those of several of his neighbours. The best remedy for this insect is the wash mentioned by Mr. John S. Woodworth, of Berwick, N. S., in my Report for 1894, viz., washing the nat. size & trees liable to attack three times,—early and late in June and once enlarged.

in July, with the following: Soft soap, 1 gallon; water, 3 gallons; carbolic acid,  $\frac{1}{2}$  pint. This same mixture has been used successfully against the Peach Bark-borer (*Phloeotribus liminarius*, Harris).

OYSTER-SHELL BARK-LOUSE (*Mytilaspis pomorum*, Bouché).—Every year brings numerous complaints of the deadly work of this enemy of the fruit grower, and 1897 has been pre-eminently a scale-insect year, owing to the anxiety about the San José scale having directed a more than usual amount of attention to these inconspicuous but frequently fatal enemies of fruit trees.

The best remedies for all scale-insects which, like the Oyster-shell Bark-louse, have only one brood in the year, is to spray the trees before the buds burst, and again in June when the young are moving, with the Riley-Hubbard kerosene emulsion (1 to 9), or with whale-oil soap, 1 lb. in 2 gallons of water. In addition,—and this is of great importance,—a healthy,

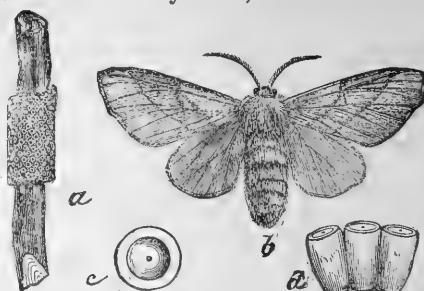


Fig. 7.—Forest Tent Caterpillar; eggs and moth.



Fig. 9.—Oyster-shell Bark-louse.

vigorous growth should be induced by manuring liberally, frequent cultivation of the land, and judicious pruning of the trees. On this point Mr. S. C. Parker, the Secretary of the Nova Scotia Fruit Growers' Association, writes:—"I notice in your report for 1896 many complaints from Cape Breton, Prince Edward Island, etc., of the Oyster-shell Bark-louse. I would like to wager a trifle that in four out of five cases these orchards are in grass, perhaps a cow pasture. It is of little use to try to grow trees in Nova Scotia or Prince Edward Island without thorough cultivation and annual application of fertilizers. I have yet to see a healthy tree growing vigorously that will spend any time bothering with bark-lice."

The APPLE MAGGOT (*Trypetta pomonella*, Walsh), referred to in my last report as the cause of considerable injury in Dr. Young's orchard at Adolphustown, Lennox Co., Ont., has apparently not increased during the past season. Dr. Young writes

"September 27.—We have a few of the Apple Maggot in the fruits of the same trees as last year, but not nearly so many as there were then. We ploughed and cultivated the ground last fall, and once in the winter when there was quite a thaw, and then again gave it a deep ploughing in the spring."

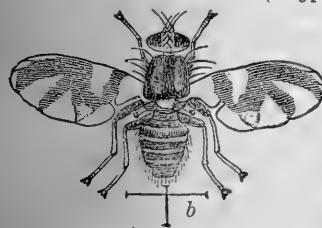


Fig. 10.—Fly of Apple Maggot.

The Apple Maggot is extremely abundant in the state of Vermont close to the borders of the province of Quebec, and Mr. J. T. Macomber, of Grand Island, Vt., writes to me that "it occurs every year and is increasing fast; in some orchards more than 50 per cent of the fruit is ruined. Numbers of the maggots are found in each apple tunnelling all through the pulp and utterly ruining it, except for stock." Fruit growers in the Eastern Townships should be on the lookout for any such injury to apples as is shown on the cut of an infested apple given herewith, or for an insect resembling Fig. 10, which shows the fly enlarged. These flies will be found after midsummer. They are dark in colour, with yellowish head and legs, with clear white bands across the abdomen. They are not very active and may be looked for on the apple trees in late summer and autumn. The remedy which is most relied on is the prompt gathering and destruction of all windfalls before the maggots leave them to go into the ground. This can be done by keeping poultry, pigs, sheep or other stock in the orchard.

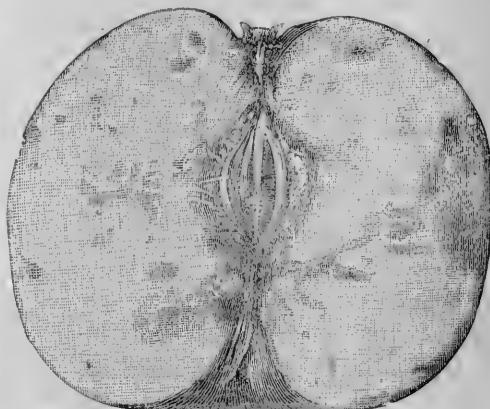


Fig. 11.—Apple infested by Apple Maggot.

The APPLE FRUIT-MINER (*Argyresthia conjugella*, Z.).—Considerable space in my last report was devoted to a new enemy of the apple which in British Columbia caused last year great anxiety from the extent and serious nature of its injuries, which closely resemble those of the Apple Maggot. Last spring the perfect insect was successfully reared both

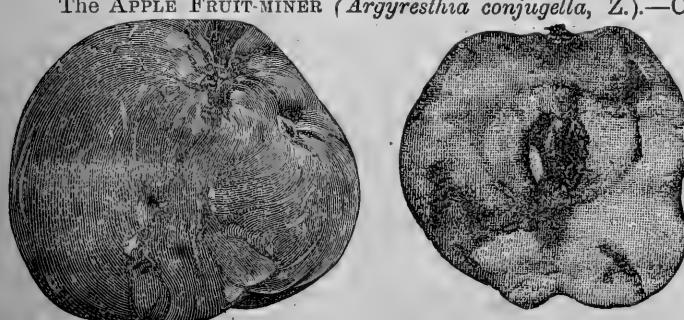


Fig. 12.—Apple injured by Apple-fruit Miner, and the same cut open.

by Mr. E. A. Carew-Gibson, in Victoria, B.C., and by myself at Ottawa. It proved to be a beautiful little Tineid moth belonging to the genus *Argyresthia*. One of the specimens was sent to Lord Walsingham, of Thetford, England, a high authority on Micro-lepidoptera, who reports as follows:—

“Merton Hall, Thetford, England, Dec. 13, 1897.—The moth which you have submitted for determination is *Argyresthia conjugella*, Z., which in Europe feeds in the fruit of *Pirus Aucuparia*, but has not been recorded, so far as we know, from *Pirus Malus*. Lord Walsingham has a worn specimen from Esquimalt, Vancouver Island, and he is inclined to think that his identification of the allied species *mendica*, Hw. (*Insect Life*, III, 118), as occurring at Washington, may have been erroneous, as the specimen was evidently not in good condition, and he would suggest that search should be made for the larvae there and elsewhere.”—[Jno. Hartley Durrant, Ent. Asst. to Lord Walsingham.]

The moth is a slender insect measuring  $\frac{3}{8}$  inch across the expanded wings. Upper wings silvery gray, mottled with darker patches. Along the inner margin, from the base to the middle of the wing, is a broad silvery band of white ending abruptly on the inner margin but in a spur running backwards at the outer angle of the band. This is followed by a conspicuous black patch, which, widest at the inner margin, runs diagonally backwards across the wing; next to this is an elongated triangular white patch mottled with brown, having the base on the inner margin of the wing and the apex elongated and directed backwards toward the tip of the wing, which terminates with an eye-like spot somewhat like a peacock’s feather. The dark gray lower wings are heavily fringed all round with long silky gray hairs, as also is the lower apical margin of the upper wings. The frontal tuft and the thorax are of the same silvery white as the broad bands on the upper wings, which come together when the wings are closed and, joining with the thorax, form a continuous white dorsal stripe from the front to half way down the wings, where it is cut off by the dark bands which cross the wings diagonally. The two white triangular patches also come together when the wings are closed, forming a crescent-shaped saddle toward the tip of the wings. When at rest the posterior end of the body is raised up at an angle of 45 degrees and the insect is supported on four legs very widely separated. At such times the moth bears very little resemblance to an insect and may certainly be easily overlooked.

Mr. Carew-Gibson was the first to breed this moth; one of his specimens which he kindly forwarded to me, emerged from the cocoon on May 20, and another a few days later. The single pair which I bred at Ottawa from apples collected at Agassiz, B.C., by Dr. William Saunders, emerged on June 2 and 3, the cocoon having been taken out of the cellar May 24. Although they were male and female, I failed to get them to pair; thus no studies could be made of the eggs and the mode of oviposition. There has been little complaint of injury by the Apple Fruit-miner during the past season. Mr. R. M. Palmer, in a valuable report on the insect injuries of the year in British Columbia, with which he has favoured me, says:—“The Apple Fruit miner, as I expected, has been very little noticed this season, although I occasionally see specimens of apples injured by it; so, it has not quite disappeared. The apple crop of the province this year has been an exceptionally good one, and the fruit better coloured and freer from scab than for many years past. The practice of spraying is now pretty general, and the season has also been favourable.”

PLANT-LICE (*Aphididae*) of all kinds and upon almost every crop cultivated have been particularly abundant during the past season in all parts of Canada except British Columbia, where, strangely enough as this province in most years suffers severely from them, there were less than usual:—

“Victoria, October 4.—Aphides of all kinds have been less numerous this summer than any year since I have been in the province. *Aphis brassicae*, however, was an exception and was very troublesome on the islands.”—[R. M. Palmer.]

“Yarmouth, N.S., November 30.—The excessive rains of April, May and the first half of June during which there was a precipitation of 18.8 inches were not propitious to insect life, except that we were visited by unprecedented swarms of Aphides that

covered all the young growth of fruit trees and were most destructive to the fruit crop. In some varieties of apples, the Gravenstein suffering most, the crop was utterly ruined, and in all it was greatly diminished. Young trees in the nursery were destroyed, or the growth for the year stopped."—[Charles E. Brown.]

"Sussex, King's Co., N.B., November 19.—On young apple trees the green aphis was in very large numbers, always with the attendant ants."—[W. W. Hubbard.]

Mr. Martin Burrell, of St. Catharines, Ont., has favoured me with the following useful observations on some Plant-lice of the orchard made by him during the past season :—

"As far as fruit-growing is concerned the different species of Plant-lice have been by far the most serious pests we have had this season. I do not recall such a scourge for many years. Every kind of fruit tree was affected, and even the weeds did not escape.

"The principal damage has been done by the Cherry Aphis (*Myzus cerasi*, Fab.), whose attacks on the sweet cherry of this peninsula were simply disastrous. I do not think I should be overshooting the mark if I said that half the crop was ruined. I saw many cases where not only the foliage was covered but even the fruit, and especially the stalks, with lice. The application of kerosene emulsion is such a "messy" business and the pressure of other work is so great at that season of the year that the pest is rarely checked on its first appearance. We shall have to dig it thoroughly into our heads that the stamping out of the early generations of both the black and green aphis is the most important work of the day. The green species did an enormous amount of harm, not only to the growing shoots of young plum and pear trees, but to the foliage of the fruiting trees, thereby impairing both the size and flavour of the fruit and further depressing already congested markets by dumping on them large quantities of half-coloured, insipid and worthless plums. It is, of course, well known that the black species of lice are more resistant to insecticides than the green. I find that the kerosene emulsion should be diluted with only 6 or 7 times the quantity of water to be effective against *Myzus cerasi*, while 1 to 12 or 14 is all right for the green forms.

"Tobacco water should be on the strong side too. I did not find 1 pound to 6 gallons thoroughly effective. A closer proportion would, I think, be advisable, and the tobacco should be boiled thoroughly. The lady-birds did good work this year among the lice, as might be expected, especially *Coccinella 9-notata*, Hbst., and *Anatis 15-punctata*, Oliv. *Myzus cerasi*, which usually keeps pretty much to the sweet cherries, appeared in my orchard of Early Richmond cherries toward the end of June, and by July 1st was increasing very rapidly. During this time the larvae of *Anatis 15-punctata* were doing good work on the lice. By July 4th most of the larvae had pupated. The pupal period was only from 4 to 6 days, and by July 10th any quantities of the beetles could be seen, the predominant colour being a creamy white or even lavender, with the characteristic markings. The lice by this time had decidedly lessened in numbers and I felt that I could leave them safely in the hands of our coccinellid friends."—[Martin Burrell.]

THE PLUM APHIS (*Aphis prunifolii*, Fitch) has been unusually abundant in many parts of the Dominion, being the Plant-louse most often inquired about in correspondence. Reports of Plant-lice on plum from Manitoba, the North-west Territories and British Columbia probably referred to a different species, *Hyalopterus pruni*, Fab., which is also stated by Prof. C. P. Gillette in the Proceedings of the Ninth Annual Meeting of the Association of Economic Entomologists to have been particularly wide-spread and very injurious to plum trees in Colorado during the past summer."

"Woodville, Lot 2, P.E.I., June 10.—I send you specimens of an insect that has over-run our orchards of plums and Damsons. They cause the leaves to curl, dry up and die in a short time. Please let me know what they are and how to get rid of them."—[Michael McGrath.]

The specimens sent with this letter were *Aphis prunifolii*, Fitch.

"Nappan, Cumberland Co., N.S., July 8.—I send you specimens of *Aphis prunifolii*. These are a terrible pest on our plum trees. The kerosene emulsion is a sure cure if it

strikes the insect, but it seems almost impossible to get at the Plant-lice when they are on the underside of the leaves."—[W. S. Blair.]

Several specimens were also sent from different localities in Ontario. Mr. A. W. Donaldson found them very troublesome at Shakespeare, Oxford Co., Ont.

"Leamington, Essex Co., Ont., Nov. 24.—The most troublesome insects we had to contend with this season were Aphids on the plum and cherry trees. They were especially bad on the plum. I have never before seen them so numerous. They came in such numbers that we could do nothing with them. I sprayed, but after the leaves had curled it was hard to get at the insects. I had to make the emulsion as strong as we dared to use it; otherwise it would not kill them."—[W. W. Hilborn.]

*Remedies.*—Many of my correspondents, while acknowledging the efficacy of kerosene emulsion as a remedy fatal to all Plant-lice, at the same time dislike using it on account of its odour and destructive effect on India-rubber hoses. Recent experiments have shown that good work can be done with some of the other washes usually recommended. Mr. R. M. Palmer, who has had a great deal of experience in treating the Apple Plant-louse and other species in British Columbia speaks very strongly in favour of the following tobacco and soap wash: "Soak 4 pounds waste tobacco in 9 gallons hot water for 4 or 5 hours (or in the same quantity of cold water for 4 or 5 days); dissolve 1 pound whale-oil soap in one gallon hot water; strain the tobacco decoction in the dissolved soap, and apply the mixture to affected trees with a spray pump, using a fine nozzle and all the force possible."

Prof. Gillette, when speaking of the attack on plums in Colorado by Plant-lice, says:—"In our experiments whale-oil soap, in the proportion of 1 pound to 8 gallons of water has been more effectual than the ordinary kerosene emulsion in destroying the lice. The powdery excretion upon the surface of these lice interferes greatly with any successful treatment unless the application be made with much force."

**THE BRONZE APPLE-TREE WEEVIL** (*Magdalis aenescens*, Lec.).—Complaints have been received from time to time of injury from this weevil, the larvæ of which infest the bark of apple trees in British Columbia. Last summer a new attack was observed by Rev. G. W. Taylor on Gabriola Island, B.C., when the perfect beetles swarmed in myriads on cherry trees and devoured the foliage.

**THE WESTERN STRAWBERRY CROWN-BORER** (*Tyloderma foveolatum*, Say).—Specimens of this British Columbian beetle were received from Vancouver Island last summer. References have been made occasionally to injuries to the strawberry plant in British Columbia by a crown-borer. As I had never found nor received from that province specimens of the ordinary Strawberry Crown-borer I was very anxious to secure specimens of this western pest, for identification. In June last I was pleased to receive specimens of the mature beetle, from Messrs. E. A. Carew-Gibson and R. M. Palmer of Victoria. These proved to be *Tyloderma foveolatum*, Say, which had not been previously recorded as a pest of cultivated crops. Mr. Carew Gibson writes "I am sending you some weevils from a strawberry patch which they have completely wiped out this spring," and Mr. Palmer writes on the same subject—"Thank you for the name of the strawberry weevil; the specimens were sent to me from Cowichan, where they had entirely ruined a small strawberry bed."

**THE Currant MAGGOT, Currant Fly** (*Epochra Canadensis*, Loew.).—Another question which has been settled during the past summer, is the identity of an insect which does an enormous amount of injury to Black Currants in British Columbia, the fruit being rendered quite unfit for use owing to the large numbers of maggots which infest it. I have for years endeavoured in vain to get specimens of the fly or infested fruit so as to breed the fly. I am now under obligation to Mr. Carew-Gibson, for an opportunity to examine some flies bred by him from these maggots.

"Victoria, May 21.—I am sending you some specimens of the flies hatched from my currant fruit worms, i.e., the insect which lives in the larval stage inside the fruit of the currant. Is this *Epochra Canadensis*? The flies hatched out yesterday (May 20), and I now recognize them as a very common fly here at certain times." The flies received were well marked examples of *Epochra Canadensis*, Loew., an insect which

notwithstanding its name *Canadensis*, I had never before seen in Canada, nor have I heard of its injuries in any other part of the Dominion than British Columbia.

In a very complete monograph upon this insect, published in 1896, by Prof. F. L. Harvey, of Maine, full details are given of the life history and habits. With the exception of British Columbia, this insect is certainly nowhere common in Canada, although like the Apple Maggot it is abundant in some seasons in the State of Maine close to our borders.

THE NATIVE CURRANT SAW-FLY. (*Gymnonychus appendiculatus*, Hartig).—This

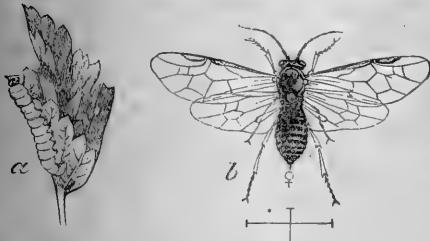


Fig. 13.—The Native Currant Saw-fly—larva and adult.

examination. These were submitted to Mr. W. H. Harrington, who has made a special study of this class of insects and he has kindly provided me with the following report upon them:—

“*Gymnonychus appendiculatus*, Hartig.—I have made a careful examination of the sawflies received by you from Rev. G. W. Taylor, and find them to be *Gymnonychus appendiculatus*, Hartig. On my first examination the insects were referred to the genus *Pristiphora*, and seemed to answer very closely to Norton's description of his *P. relativa*, the type of which was from Great Slave Lake, collected by R. Kennicott. On reference to Cameron (*Brit. Phytophagous Hymenoptera*, II., p. 66) the description of *Nematus appendiculatus* was found to apply very closely to the Vancouver Island specimens, and a microscopical examination of the claws shows that the species belongs to the new genus *Gymnonychus* erected by Marlatt (*Nematinæ of N. A.*, p. 122) for those species of *Pristiphora* having the claws entirely untoothed (*gumnos* = naked, and *onux* = a claw). The species, therefore, is now named as above cited and is the currant saw-fly named by Walsh as *P. grossulariae*, and treated of under that name by Walsh, Packard, Glover, Riley, Saunders and other writers (see Marlatt, *loc. cit.*). Norton's *P. relativa* may possibly be identical.—[W. H. Harrington.]

### THE SAN JOSÉ SCALE

(*Aspidiotus perniciosus*, Comstock).

“Well, how about this San José Scale we hear so much about?” is a trite question which has been very frequently put to the Entomologist during the past season.

Early in the present year undoubted specimens of the San José Scale were received for examination from orchards near Chatham, Kent Co., and from near Niagara, Lincoln Co., in western Ontario.

In 1894, in anticipation of the spread of this most injurious pest of the orchard from infested States to the south of us, and so that our fruit growers might be warned beforehand, articles were prepared and published in the report of this Division, the *Annual Report of the Entomological Society of Ontario* for the same year, and the *Farmers' Advocate* of London, Ont., an influential agricultural journal with an extensive

circulation. In these articles will be found a full account of the life history and development of the insect, characters by which it may be recognized, and what were at that time thought to be the best means of fighting against it. Ever since it became known certainly that this scourge had effected a footing in our orchards, great anxiety has been shown by fruit growers in all parts of the Dominion, to obtain reliable information about it. Numerous specimens of various kinds of insects, fungi, corky excretions on the bark, etc., have been sent in for examination. The importance of every one concerned being enabled to recognize this pest as soon as possible, so that prompt action might be taken to control it, suggested the advisability of issuing last summer a large wall poster which could be put up in conspicuous places such as post offices, railway stations, newspaper offices and public halls throughout the district, where the scale was likely to occur.

This poster (2 ft. 3 in. by 1 ft. 8 in.) was got up much in the same form as a similar poster issued by Prof. Webster, the State Entomologist of Ohio, on the same subject and gave the excellent illustrations prepared by direction of Dr. Howard, the United States Entomologist, showing an infested pear and a piece of a branch, also enlarged figures of the female insect and her scale. The object of this poster was to warn fruit growers that the scale was already in Canada and that if it were allowed to spread great loss would certainly result. The best way to recognize the pest was given, with advice as to the course to pursue, should it be discovered in an orchard.



Fig. 14.—Branch infested by San José Scale.

Fig. 15.—Pear infested by San José Scale.

A great deal has been written concerning the San José Scale since its unfortunate introduction into the East, and its detection as a serious enemy of fruits by Dr. Howard in August, 1893. This scale has been treated of at considerable length in previous reports of this division, and numerous articles in government publications are accessible to any one who wishes to inform himself on the subject.

For the purposes of this report, it seems more useful to give a concise account of the insect, its appearance, so that it may be recognized, its life history, occurrence in

Canada, and the most approved remedies so far tried; also to answer briefly some of the pertinent questions frequently asked by correspondents and others concerning it.

*What is the San José Scale?*—It is a very small (the largest specimens, not more than  $\frac{1}{8}$  inch in diameter) round, flattened and inconspicuous scale-insect; that is, like the well known Oyster-shell Bark-louse and the Scurfy Bark-louse, a sucking insect covered by a waxy scale, which, as we find it on trees, is the only part visible, except in the early larval stage, when scale insects for a few days have the power of walking.

*What it is not.*—From the many different kinds of insects which have been sent in, it seems advisable to state that the San José Scale is not an easily seen insect resembling a beetle, a grub or a spider, nor has it well-developed wings and legs, but it is a minute creature which can only be detected by the closest examination, and even then requires some skill and experience to recognize it as an insect.

Among the objects which have been received under the supposition that they might be the San José Scale, were many things which in no way resembled scale-insects; but some, such as the small corky excrescences known as lenticels, which are found upon the young bark of some trees—apples, pears, birch, walnut, &c.—and certain minute fungi which are found on dead wood, do bear some resemblances to scale insects. Their different nature, however, may generally be easily detected by the fact that they cannot be detached from the bark without tearing the tissues, whereas all scale insects may be removed easily from the surface of plants by a gentle pressure.

*How to know it.*—The general appearance of the bark of infested trees is dirty, scurfy and grayish in colour, as though dusted with ashes. The scales usually are found in enormous numbers, frequently overlapping or occurring altogether on the top of other scales; they may be found throughout the summer of all sizes from the newly hatched mite-like larvæ to the fullgrown insects. In severe cases of infestation this massing of the scales produces a scurfy, dirty appearance of the bark, which when once seen is easily recognized. On young twigs, fruit and leaves, there is usually a well defined purplish ring surrounding each scale which is sometimes useful for detecting its presence when the scale itself might be overlooked; and although this purpling effect is produced by a few other scales, such as the Putnam Scale (*A. aencylus*, Put.) and the Forbes or Cherry Scale (*A. Forbesi*, Jnsn), it is particularly characteristic of the San José Scale, and even upon large branches, although invisible at the surface, may be found by cutting away some of the outer bark.

The scales of the males and females differ somewhat in shape.

*Female:*—Scale very thin, almost circular in outline, much flattened; size ranging from  $\frac{1}{20}$  to  $\frac{1}{8}$  of an inch in diameter; white at first, becoming grayish or blackish, particularly in the centre, and later much blackened by the fungus *Fumago salicina*, so common on trees attacked by many kinds of bark-lice and plant-lice.

In the centre of the scale there is a small dark, or when the insect is dead or rubbed, yellow, nipple-like elevation surrounded by a distinct circular depression, which, as pointed out by Prof. Webster, is one of the best distinguishing marks between this scale and some closely allied species.

*Male:*—Scale about half the size of that of the female, rounded-oblong, with the nipple-like elevation plainly nearer to one end than the middle.

The drawing herewith shown was made by Dr. C. E. Saunders from a group of scales found upon a plum on 25th of July last. They are all, therefore, of the first brood of the season, although certainly some of them were born later than others. The first young of the year were reported from Niagara on 1st of July, so that the largest specimens would be about three weeks old. This was by Mr. Charles Thonger, a careful observer. Male insects almost ready to emerge from their scales, were found among the scales shown in the figure.

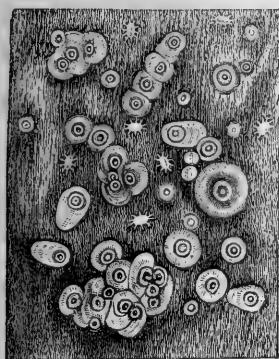


Fig. 16.—San José Scales, male and female—enlarged 6 diameters.

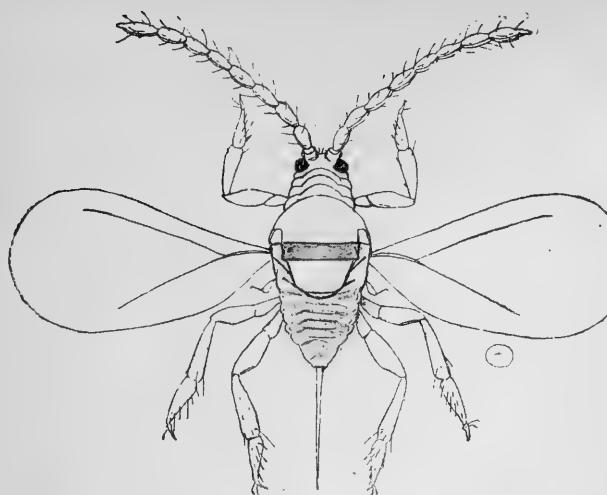


Fig. 17.—San José Scale, male—much enlarged. The natural size is shown by the line in the circle below the right wing.

to produce young varies with locality and climate. In Arizona the young larvæ are recorded as appearing in March. At Washington it is by the middle of May; in New Jersey during the last days of May; in the state of New York, early in June. At Amherst, Mass., they were first noticed 12th June, and, as far as I can learn, in our Niagara district between the middle of June and 1st of July. Most careful observations have been made under direction of the United States Entomologist, by Mr. Theo. Pergande. The following condensed life-history is compiled chiefly from *United States Division of Entomology, Bulletin No. 3, N.S.*, in which Mr. Pergande's observations are recorded.

The adult female gives birth to living young, instead of laying eggs like most other scale insects. Ordinarily, as with the Oyster-shell Bark-louse, eggs laid beneath the scales, in the course of a longer or shorter time, hatch, and the young larvæ migrate to different parts of the plant; but in the case of the San José Scale living young are produced day and night for a period of nearly six weeks before the exhausted female perishes, and this at the rate of about nine or ten every twenty-four hours. After birth, the young larva remains motionless for a short time beneath the scale of the mother, it then forces its way out and runs over the plant, seeking a suitable place to settle. It is a microscopic creature, pale orange in colour with an oval body, six legs and two feelers. The long thread-like proboscis, with which it sucks the sap of the plant, is doubled on itself and lies in a groove of the body wall. After crawling about for a few hours, the larva settles down and works its bristle-like sucking tube through the bark and remains fixed, if it be a female, for life, and if a male, until fully developed, when it will have a few hours more active life, during which it can fly about.

The development of the scale begins even before the larva becomes fixed. The secretion of the scale starts in the form of very minute white waxy filaments, which spring from all parts of the body and rapidly become more numerous until, within two days, the insect is entirely concealed by a whitish shell or scale, which has a prominent central nipple. The scale is formed by the matting and melting together of the waxy filaments. As in the development of most insects, there are also with these scale-insects distinct periods of the larval life, divided by moults of the skin, and, in the case of the males, marked by important structural changes. The first moult takes place when the larva is twelve days old. Up to this time, the male and female scales are exactly similar in size, colour and shape; but after the moult the insects beneath the scales bear no resemblance to each other; the males are larger than the females and have large purple eyes; while the females have lost their eyes entirely. The legs and feelers have disappeared in both sexes. Eighteen days after birth the second moult occurs and the males change to the first pupal condition (pro-pupa). The male scales now assume an

*Life History.*—The winter is passed by the partially grown insects beneath their scales. With the return of warm weather the next spring, growth is resumed, and the males reach maturity a few days before the females. They are extremely small two-winged flies (Fig. 17) and when examined under a magnifying glass are found to have orange yellow bodies, iridescent dusky wings and black eyes. These minute creatures have no mouths, so can take no food; consequently after having fertilized the females they very soon die.

The date when the females become full-grown and begin

elongated shape. The legs and feelers have appeared again, and there are now prominent wing pads extending along the sides of the body. About twenty days after birth the male insect changes to the true pupa, in which all the parts shown in the pro-pupa are much more developed, and a slender organ at the end of the body called the style has appeared. From four to six days later, or from twenty-four to twenty-six days after birth, the males mature and emerge by backing out from the rear ends of their scales; this is chiefly by night or in the evening.

The changes which have gone on beneath the female scale are less striking than those described above. After the first moult the body of the female is practically an almost circular, flattened sac, with indistinct segmentation and without any visible organs, except the long sucking bristle with which it draws up continuously the sap of the tree it is infesting. The female moults a second time about 20 days after birth, and the last segment now shows the important characters of the mature female, which are of so much service in the exact identification of the species. The segmentation of the body at this stage is quite distinct.

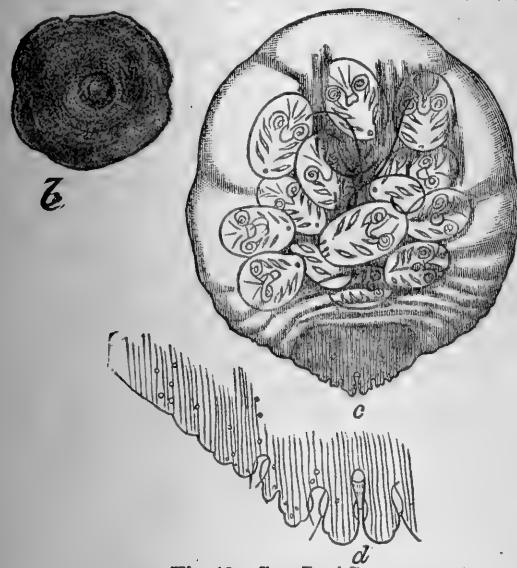


Fig. 18.—SAN JOSÉ SCALE.

(b.) Scale much enlarged. (c.) Female showing young, much enlarged. (d.) Anal lobes of female.

servations, it covers a period of from 33 to 40 days from the time a young larva appears until it develops into a mature female bearing young. The San José Scale is enormously prolific. It has been calculated that a single female may be the progenitor of 3,216 million descendants in a single season.

The exact identification of the species is of the greatest importance, for the San José Scale is now known to have many very bad characteristics not possessed by several other scales which resemble it very closely in appearance; and these make it a matter of public interest that no effort should be spared to control so dangerous a public enemy whenever it is detected in a new locality. The chief differences, in this connection, between the San José and some of these other scales are: (1) the fatal effects on the tree due to its greater rapidity of increase, and (2) certain minute but important structural characters which can be seen only with the help of a microscope.

The careful experiments at Washington, already alluded to, show that in one season from a single female an increase of 3,216 millions is possible. It is not, of course, to be expected that all of these would survive; but with the San José Scale there are many circumstances which make it less liable to diminution than many other insects. As a matter of fact, it is known that this scale does not spread from a new point of infestation with very great rapidity to contiguous trees, and also that, when once established upon a tree, it soon increases enormously in numbers—indeed, unless checked, usually spreading rapidly over the whole tree and destroying it. This rapid increase is characteristic of the species and is due, of course, to the great fecundity of the females. The fact that they bring forth their young alive throughout the season and that these are very quickly protected by a scale which is impervious to many liquids, affects very

seriously the question of remedies, making it necessary to apply several successive treatments, if it is hoped to thoroughly free a plant infested by this enemy so difficult to conquer.

The mere fact of a scale-insect occurring, even in vast numbers, upon a given plant does not necessarily prove that the species is a dangerous enemy to that kind of plant; for, although it may possibly be so and should be regarded with suspicion, this habit of occurring in great numbers on isolated trees, but on no others surrounding these, has frequently been noticed with scale-insects, and is probably due to some lack of vigour in the individual tree. In the case of the San José Scale, on the other hand, if other trees are reasonably near, it is almost certain that they will soon become infested; and, when a severe case of infestation is found, one of the first things looked for when considering whether the pest is actually the San José Scale or one of the other species which superficially resemble it very closely, is, whether surrounding trees are also infested.

This important difference of habit in spreading and the much more fatal effects upon trees from the presence of the San José Scale, make much more stringent measures necessary to secure its eradication than with many other species, even frequently rendering it advisable or imperative to destroy many trees, if not whole orchards. This being the case, the very great advantage is obvious of being perfectly sure as to the identity of an infesting scale-insect before valuable trees are condemned to destruction.

Unfortunately, as stated, there are several species of scale-insects which bear a very close superficial resemblance to the much to be dreaded San José Scale. On this point, which has been referred to by many entomologists, Mr. T. D. A. Cockerell, a high authority, may be cited: "It has been a matter for dispute whether the San José Scale can be certainly recognized in the field. Its effect on the tree, killing the branches, is characteristic, but hardly in any sense diagnostic, while the reddening of the tissues of the plant adjacent to the scale is sometimes well marked with *A. aencylus*, as well as with *perniciosus*. A little experience, however, enables one to recognize the ashy gray, generally thickly massed scales of *perniciosus*, with the dot and ring of the male scale, as against the dark scale and contrasting reddish orange exuviae of *ancylus*, or the similar scales of *ostreiformis* and *Forbesi*. At the same time, it is to be recommended that the diagnosis made in the field be in every case confirmed by examination of the insect under the compound microscope if either locality or plant is new." (*Technical Series, Bull. 6, U. S. Div. of Ent., 1897.*)

The above is from a valuable pamphlet prepared under Dr. Howard's direction for the special purpose of helping students to distinguish between these different scale-insects. Prof. F. M. Webster says: "I know of no insect the detection of which has given expert entomologists more trouble than this one. Its extreme minuteness, its close resemblance to the other species less harmful, and the frequency with which it is found concealed in cavities and about the wrinkles of the bark or under buds, render its detection, when present in limited numbers, a matter of extreme difficulty." (*Ohio Bulletin 81, p. 183.*)

For the exact separation of these closely allied species it is necessary to take the females from beneath the scales and examine them under a microscope after special preparation. The differences are then readily seen, but these are beyond the power of ordinary pocket lenses or magnifying glasses, and require compound microscopes, which are expensive instruments not in the hands of ordinary fruit growers, and for the use of which special knowledge is needed.

As, therefore, there are several kinds of scale-insects resembling each other so closely at first sight as to make it necessary for even expert entomologists to examine them with a microscope before being positive as to the identity, and as one of these, to wit the San José Scale, is extremely injurious and the others not nearly so much so, we invite all fruit growers to send for examination and report specimens of any suspicious scale-insects which they may find upon their trees before they adopt extreme measures or even decide upon what measures they will take to free their orchards. Not only does the San José Scale spread more rapidly than many other species, but it has been found much more resistant than others, to the ordinary applications used for scale-insects.

*Food Plants.*—The list of plants upon which the San José Scale has been found as a serious enemy is a very large one and may almost be said to include all deciduous trees and shrubs, and it has also been found in Maryland by Prof. W. G. Johnson, upon such unlikely plants as milk-weed (*Asclepias*) and crabgrass (*Panicum*). It is particularly noted, however, that the San José Scale does not attack Conifers—pines, spruces, cedars, &c.—and has not so far infested injuriously any of the citrus fruits, such as oranges, lemons, &c., although it has been found on these trees, and in the case of one species *Citrus trifoliata* was found in large numbers in New Jersey by Prof. J. B. Smith.

The botanical order to which most of the food plants belong is the Rose family. So far, I have seen specimens of this scale in Canada, upon the following trees: pear, plum, peach, black currant, apricot, apple, Russian mulberry and Japanese walnut.

So far as we know, the Forbes Scale has similar food habits, but Prof. Cockerell says that *A. aencylus*, the Putnam Scale, differs somewhat. This last is especially a maple species but will flourish on poplar, oak, etc. It does not seem to take very kindly to fruit trees as a general rule. It also does well (probably best) in the Transition faunal zone, whereas the San José Scale belongs to the more southerly Upper Austral. In Canada both the Putnam Scale and the Forbes Scale have been found on plum, pear, apple and cherry trees.

"The manner of attack is different, more or less, in the various species under discussion. *A. aencylus*, on fruit trees, will be found upon the smaller branches, but in my experience more or less scattered, rarely in any great quantity. *A. perniciosus* is found largely upon the branches, becoming very abundant, covering and killing them. On the young shoots the reddening effect is very marked, though *aencylus* will also produce reddening. *A. Forbesi*, as seen on apple trees in Mesilla (N. Mex.), occurs largely under loose bark on the trunk, wintering there in numbers, and only invades the branches in limited quantity. Thus there may be quite a lot of *Forbesi* on a tree without its being noticed."—(T. D. A. Cockerell, *Technical Series, Bull. 6, U.S. Div. of Ent.*, 1897.)

"At first glance it is not easy to distinguish this species (*A. Forbesi*, the Forbes Scale), popularly known as the Cherry Scale, from the San José Scale. The purplish tinge of the bark is also quite conspicuous on some varieties of apple and pear where the Cherry Scale has established itself. The general appearance of the last segment of the female very closely resembles that of the San José Scale; but it can readily be distinguished from that species by the presence of spinnerets."—(Willis G. Johnson, *Proc. 9th Ann. Meeting, Ass'n Econ. Ent.*, 1897.)

*Means of Distribution.*—It is thought probable that most scale-insects are distributed while in the minute larval form, chiefly by means of larger insects and of birds. Since the San José Scale has been so critically studied, this has been actually proved to be the case with that species, the young larvæ having been frequently observed crawling upon lady-bird beetles of several kinds, ants, and other insects which resort to the trees during the breeding season. Isolated colonies of scale-insects in the tops of otherwise uninfested trees and in close vicinity to the nests of small birds have doubtless originated in this way. It is stated that the larvæ are also carried by the wind; this seems difficult to understand, but has been proved by Mr. W. G. Johnson in Maryland. This insect may also undoubtedly be distributed by means of farm implements, domestic animals and workmen attending to orchards.

Much has been said about the danger of distributing the San José Scale through the sale of infested fruit; but, after considering the matter very carefully, I must still differ in opinion from many good entomologists who think that there is great danger from this cause. Fruit badly infested by the scale is generally disfigured too much to be marketed, and upon fruit which is not sufficiently injured to be condemned for the market the chances of the scale-insects surviving a long journey after the fruit is removed from the tree, packed and shipped, and then of its being peeled and the peelings thrown out in an orchard or near enough to a tree for the young larvæ to infest it, are so slight that I cannot even see the necessity of considering this danger. Further, I have failed to hear of a single instance where infestation could be attributed to such a cause, but it would, of course, be well, should any one detect the scale upon imported fruit, to be careful to burn all peelings and not throw them out in a yard or garden.

where, in the event of any of the insects being alive and breeding, the young might be carried on to surrounding trees by flies or other insects attracted to the peelings during the short time that they were still moist.

*Fatal effects of Infestation.*—It has been noted by all observers that plants attacked by the San José Scale die with greater rapidity than from the attacks of other insects. "In the whole category of injurious insects we have not another one that is so difficult to detect, so pernicious in its effects and which breeds so rapidly as the San José Scale."—[F. M. Webster, Wooster, Ohio.]

"If the tree survives the attack, the infested wood becomes knotty and irregular, partly from the sapping of the juices by the insect and also without doubt largely from the poisoning of the sap of the cambium layer by the punctures of the insect, as indicated by the coloration. Young peach trees will ordinarily survive the scale only two of three years. Pears are sometimes killed outright, but generally maintain a feeble, sickly, existence, making little or no growth for a somewhat longer period."—(Howard & Marlatt, *Bull. 3.*)

Whether from the fact that the climate of Canada is not so well suited to the rapid increase of this scale as the warmer regions to the south of us, or from some other cause, it would appear to take a longer time in Canada for the San José Scale to produce fatal effects upon infested trees than stated above, and I only mention this as it has been several times referred to by correspondents when discussing whether or not the scale insect which has been found in Canadian orchards is really the San José Scale. Unfortunately, there is not the slightest doubt about this, and disastrous results have already attended its presence in Canadian orchards. To the credit of those fruit growers on whose grounds this scourge has been detected, it may be said that they have endeavoured to stamp out the occurrence promptly, sometimes at what seemed to those who did not understand the gravity of the case, to be a considerable and unnecessary sacrifice. The danger of heavy pecuniary losses in the various kinds of fruit trees, as well as in shade trees and ornamental shrubs, should the San José Scale be allowed to spread in Canada, must not be lost sight of, as there is hardly a deciduous shrub or tree which it will not infest. Now is the time to put forth great efforts to eradicate the pest wherever it may be found. The Federal Government and the Provincial Governments of Ontario and British Columbia are using every effort to learn of any occurrences in the country, and fruit growers will be suicidally foolish if they adopt the narrow-minded policy of trying to hide the fact if they have been so unfortunate as to accidentally introduce the pest into their orchards. A single tree neglected may be the means of infesting a whole orchard, from which the trees in every other orchard, garden, public park or cemetery in the neighbourhood may suffer irreparable injury.

*Occurrence in Canada.*—The San José Scale is now known to occur in injurious numbers in a few Canadian orchards. These are situated in the fertile peach districts of the province of Ontario. The most western points in Ontario where infested orchards have been found are near Kingsville, Essex County, and Chatham, Kent County; others occur in the neighbourhood of Niagara and St. Catharines, probably the orchard worst infested being actually within the limits of the last named town.

In British Columbia there have been four distinct occurrences, all of which have been promptly eradicated through the energy of the active Inspector of Fruit Pests, Mr. R. M. Palmer, who saw that every infested tree and those immediately surrounding them were cut down and burnt as soon as the scale was detected. The localities where the San José Scale was found were at Kelowna, on the shore of Okanagan Lake, in 1894, at Victoria in 1896, and at Salt Spring Island and Nanaimo, on Vancouver Island, during the past summer.

The first occurrence of the San José Scale in Ontario, as far as I can learn, was on the grounds of Mr. John Van Horn, of Chatham, Ontario. This gentleman has made every effort to eradicate the pest and has kindly kept me posted during the season on the progress he was making against the scale. I have been similarly favoured with regard to the Niagara outbreaks by Mr. Charles Thonger, of Niagara, a practical and successful fruit grower and an accurate observer, moreover, possessed of the most remarkable eyesight for detecting San José Scale or any other injurious insect, also by

Mr. Martin Burrell, of St. Catharines, a trained observer and a practical fruit grower, who has studied injurious insects for many years, one, therefore, who was well calculated to observe and record any matters of value bearing upon the presence and increase of the San José Scale and the general condition of any orchards visited. All of these gentlemen, as well as Mr. M. G. Bruner, of Olinda, Essex Co., Ontario, who has observed carefully since its discovery the occurrence of the San José Scale in the orchard of Mr. John D. Wigle, at Kingsville, have favoured me with voluminous notes upon this important subject during the summer, and, as their experience and notes, both as to means by which orchards have become infested and the effect of measures adopted to control the spread of the San José Scale, are of general interest, I give herewith lengthy extracts from their letters.

Mr. Van Horn's letters :

"Chatham, Kent County, Ont., Jan. 12, 1897.—I have, unfortunately, got San José Scale on a lot of fine young plum trees. I am preparing to dose them with the California mixture mentioned in your report of 1894."

"Jan. 19.—I send you cuttings of Simoni plum and Lombard plum covered with what I think is San José Scale. Kindly give me all information at hand."

"Feb. 11.—Yours of the 9th received with thanks. Two years ago this spring I ordered a lot of plum trees from Parry's 'Pomona' Nurseries, New Jersey. Among the lot was one dozen Simoni plum trees—a fine lot of well grown and handsome trees. After putting out, they all grew finely; all made vigorous growth in spite of a very dry summer. During the summer I received a circular from the nurserymen saying that San José Scale had got into their trees, imported from California, and stating that no further danger need be feared, as they were disinfecting all stock after discovering the pest. I paid no more attention to it, as my trees were doing so well. I did not notice anything wrong till this winter, and one day while going through them I noticed four of the Simoni looking sick, the bark looking as if dusted with ashes. As the disease was new to me I sent samples to them, as well as to you. They (Parry's) like yourself, answered that it was the dreaded scale all right, and recommended digging out and burning if badly affected, and if but slightly, to wash with whale-oil soap. I cut off two trees near the ground, intending to drench the stumps and let the trees sprout again from the roots. Those only slightly affected, I cut back severely and have sprayed with the salt, sulphur and lime mixture and will go over them again shortly with the same, and then later on will give them a dose of whale-oil soap suds.

"The trees were ordered direct from the nursery and not by agents, so there may be no more in this part of the country. I have examined a number of my neighbours' orchards, but can find no trace of the scale. I am very anxious to wipe it out, so that it may not spread to my neighbours' orchards, as well as the rest of my own. If I thought it necessary, I would dig up and burn all infested trees, but with your kind assistance by way of advice, I would be delighted to master it otherwise. I am very fond of fruit growing and dislike very much to be beaten by such things as San José Scale or any other pest and will conquer it if I can."

"April 8.—I got the trees from Parry's nurseries. I gave my son-in-law, who lives a few miles from me, a nice Simoni tree. I did not see the tree again till last week, when I was helping him trim his trees. On coming to his Simoni, which he was very proud of, as it had grown so much last summer, I said, 'You had better get your spade and dig it up at once,' for it was crusted all over with scale. I took my magnifying glass and let him see for himself. I did not lose sight of the tree till it was in the fire. I could see no signs of the scale on his other trees, and I hope they are not infested."—[J. Van Horn.]

At the end of the season Mr. Van Horn wrote to me that he believed his orchard was quite clear of the scale. During the month of December, 1897, I visited his orchard and examined the trees very carefully. I found the following state of affairs. Of the two trees which were badly infested, one had been dug up and destroyed entirely, the other was cut off last winter within a few inches from the ground and thoroughly drenched with the "lime, sulphur and salt" mixture and subsequently with the whale-oil soap solution. This stump had thrown up during the summer some vigorous

young shoots upon which no trace of the scale could be found, although on the old stump many of the scales which had been killed by the treatment given them last winter were still discernible. Besides these two badly infested trees, those which were slightly affected and had been severely cut back last winter and then treated, had made vigorous growth. Upon some of these a very few living scales were found, showing that, although the treatment with whale-oil soap was extremely effective, rendering it possible to find the scales only by very close search, yet it was not absolutely so, as there were a few still alive. Mr. Van Horn had attended to this matter very carefully, being much interested in it and being also keenly solicitous for the welfare of his neighbours. Every tree in his orchard had been sprayed, and he intends to repeat the operation regularly during the coming season.

Mr. Thonger's letters :

" Niagara, May 10.—I have discovered San José Scale on several of my trees, but do not think it is in any other orchard in the neighbourhood as yet, as nobody seems to know anything about it. I have dug out several dwarf trees—the worst—and sprayed with whale-oil soap solution all those immediately surrounding the infested spot. That was on Thursday last, and I thought these looked cleaner a day or two after, and I almost regretted that I cut down the others ; but this may be fancy. I feel considerable responsibility in the matter and shall be glad of any information you can give me."

" May 11.—I send you to-day some infested twigs (pear tree). I have selected them with the object of showing the difficulty of detecting the scale when only a few are present, rather than the extreme stages, when, the whole trunk being covered with a mass of scales that hide the bark, it is obvious enough.

" I noticed only one tree last summer and was struck by its disgusting appearance. This tree was planted eight years this spring. Including this tree, I have taken out to burn seven trees as too badly infested to cure, and left about as many nearly as bad, to spray. The infested stock must have been from F. C. Young, Rochester, N.Y., and planted in May, 1894 ; or perhaps with a replace not later than 1895. This would indicate that the scale may spread one or two seasons without being observed, or even longer, or migrate from the infested stock and develop quicker in the new location. The infestation is evidently very slow in developing to such an extent as to attract attention, unless it happens to strike a pear tree or one as favourable to its growth and development. The scale appears to have started in the south-west corner of a plot and spread north and east to some 50 trees. I must spray the whole plot, and will try and keep you informed of my progress.

" My farm is well situated for isolating the attack. On the lake shore there is nothing to take the infestation to the north-east or west.—I think the wind has much to do with spreading it—and the infested area is well sheltered by woods from all quarters but south-west to south-east. I think it would be quite to the interest of the fruit growers of this country if the Department of Agriculture would send an expert here to examine into the matter on the spot, and decide what is the best thing to do and to assist in carrying it out.

" It is clearly of the utmost importance to prevent the scale from getting a foothold in the country. The Black Knot experience shows that the individual growers will not take the pains to eradicate a pest that does not kill the tree at once, but this sort of action will not do in this case. Rather than assume the responsibility, as well as the cost, of attempting to fight the pest myself, I would rather cut down and burn every infested tree ; but I do not think that course would be in the best interest of either the country or myself."

" May 27.—I have been making a tree-to-tree examination through the orchard, taking row by row and have found two peach trees much farther away from the pear trees than the dead tree of which I sent you samples. The nearer tree is one about ten years old. I think the confidence we have had in the precautions to keep the scale out of the country is largely to blame for the hold it has now among us. I cannot look at this tree without the conviction that, had I even glanced at it three years ago with scale in my eye, it must have been detected at once. Even last summer, when seen on the pear tree, I was quite unsuspicious, and only when two men who have been among fruit

trees all their lives said they had never seen it before, did I think it must be the dreaded scale.

"The most remarkable thing I observe among the peach trees is the limited area to which this scale is confined. An infested tree will have one or two limbs affected, and the others, perhaps, quite free, with only a few scales scattered about the base of last year's laterals. On the trees immediately surrounding the infested one, perhaps only a scale or two can be found, or in some instances a few small groups of six or eight. I marked the spots with red lead as I came to each tree, and on trees considered centres of infestation I drew two rings round the trunk; the others with few scales, or even one only, I marked with red spots. There is no danger of losing them and I shall know just what spraying to give when I get the material. I recognize about three centres of infestation among the peach trees, and some 50 trees that should be thoroughly sprayed, over and above the pear trees."

"July 5.—I first noticed the young on Saturday, 3rd inst., and by Monday noon they were quite plentiful on the trunks of infested trees and even a few on the fruit of the pears. They are extremely minute, nearly globular in form and, as far as I could see with a magnifying glass, without any vestige of legs or head; the colour, a light yellow verging to white. The characteristic stain is quite marked on the fruit and makes the nature of the minute spot distinct. The scale is more abundant than might be expected, even on pear trees painted with a 2-pound to the gallon whale-oil soap solution."

"July 21.—The samples I send you are from a tree treated three times with soap spray (the last time of 1 pound of soap to 5 gallons of water), and once with kerosene emulsion strong enough to nearly strip some of my peach trees of leaves. The young scale comes out freely on to the new pear wood and fruit, but I have only seen one young scale on a new peach shoot; perhaps later in the season they may work out. Probably the fuzz on the peach would protect the fruit from the inroads of the scale, so that fruit from an infested peach tree would have little, if any, effect in spreading the pest.

"It looks as if painting the trees with a 2 pound to the gallon soap solution had but little effect on the old scale. In places where they are thick I can squeeze out quite large insects."

"November 27.—I have not myself seen any more cases of infestation than my own, but a man who has been cutting back in my infested trees the last month or so and who knows the appearance of the scale well, tells me that two or three days ago he had found numerous adult scales and young on trees in his village lot, and that his neighbours have several trees as badly covered with scale as any of mine, and also a considerable quantity on another adjoining orchard of several acres, the grower of which talks of cutting out 8 rows so as to reduce the area of infestation to dimensions which he thinks he might treat with some prospect of disinfecting them.

"From the time the first brood of lice came out till September 9, I sprayed my infested pear trees with the whale-oil soap solution (1 pound to 5 gallons of water) once a week. I think it had very little, if any, effect in checking the increase of the scale on those trees, for all those slightly infested in the spring were almost covered as badly as the few I had taken out at the beginning of the season. I have since taken out and burned all the pear trees, dwarf and standard, in the small orchard that you saw near the house. Some of the trees at the north end were not affected and were doing well, but blight as well having got hold of many I did not think it worth the risk and trouble of further treatment. I intend to concentrate all my efforts on the peach trees. I am cutting them back (especially those infested) as far as I think the tree will bear, not to kill it, and hope to do something to keep the scale in check. I have very little hope whatever of getting rid of it entirely. I find infested trees through an area quite eight times as large as was infested in the spring, chiefly on trees three and four years old. These are easier to examine than those larger, but it indicates that quite half of the orchard should be treated to have even a chance of not missing any. I am considering now either to spray the whole orchard next year with kerosene and water, say from the end of April till the leaves or blossoms come out, in hopes of keeping the infes-

tation down and raising a crop ; or with a scalding spray of either soap solution or pure water ; but either course involves considerable outlay.

"I am really thoroughly disheartened in the matter, being convinced that we have either to destroy the infestation absolutely at once or be ruined by the expense of keeping it so far under control as not to destroy the trees or crop. It is just one of those things like a house on fire in a town, the whole force of those interested should at the beginning have been concentrated on the infested spots to smother it out.

"You ask, July 26, to note what distance young scales travel from the mother. In the summer I saw on pear shoots 18 or 20 inches long, young scales of the first brood only three or four leaves away from the extreme ends of the shoots. These were few in number, but the mother scale could not have been closer than the terminal bud of last year's growth, and most likely not as far out as that. This year, on Nov. 10, thermometer 55 degrees, cloudy day, I saw young lice crawling about. The first brood of the year did not come out till the first week of July, with a temperature of about 85 degrees in the shade.

"The man who told me he found scale three days ago said there were lots of young lice, and he thought he saw them move. The day was rather warm, south wind and about 60 in the shade."—[Chas. Thonger.]

Referring to Mr. Thonger's suggestion to spray with a scalding hot spray. I have found the application of hot spraying mixtures in the first place impossible, because the breaking up of the liquid into a spray causes it to cool before it has reached a distance of one or two feet from the nozzle, and, besides this, all hot water remedies are both extremely inconvenient to use and to make, and also very destructive to apparatus.

I have not had an opportunity of visiting this orchard myself this autumn ; but I know Mr. Thonger to be a close observer, and he has reported to me from time to time on the progress made. Mr. Burrell has also visited this and some other infested orchards in the neighbourhood of St. Catharines, and his report appears herewith. I have been lately shown a letter published by Mr. Thonger in the *Rural New Yorker*, in which he speaks of treating his infested trees mechanically with a wire brush to free them of the scale. Although undoubtedly by this method a large number would be destroyed, still, this being an imperfect method, as many scales must necessarily escape the brush, I fear that it would be a dangerous practice to adopt, owing to the feeling of false security which would be created from the apparent cleanliness of the trees. They might seem to be quite free from scale, but it would be impossible to treat the scales on the branches and small twigs with such a brush, and, judging from experience in other matters, I am confident that, although Mr. Thonger might follow up the brushing of the trunks with a thorough spraying of coal oil emulsion or of whale-oil soap solution, many others would not do so owing to the extra amount of labour and time necessary for two operations.

#### Mr. Martin Burrell's observations :

"St. Catharines, Ont., Oct. 11.—With reference to your inquiry as to the San José Scale, its spread, development, &c., I am very happy to give the results of my own observations in this district. In the two orchards where the scale is at work, there has certainly been an extension of the infested area since spring. The infestation of new trees has, however, not been nearly so marked as the extraordinary increase of the scale on trees that were only moderately attacked in the spring. In the latter case the scale has, in nearly every instance, spread over the whole tree, including leaves and fruit. On one three year old Japanese plum tree which was affected severely last year only on the trunk and the bases of the main limbs, the insects had spread to such an extent by the middle of July that out of 407 plums on one tree, 405 were attacked. One plum had on its surface upwards of 450 newly set scales, and in more than one case there were between 1,500 and 2,000 scales on a single leaf. When the breeding process is in full swing, the trees appear to have been dusted with a yellow powder. So minute and in such numbers are the insects, that on a raised piece of bark no bigger than a pea I have carefully estimated that there were more than 150 larvæ. It has been stated by some that the larvæ are not very active and move but an inch or so from the parent scale. The facts I have mentioned rather contradict this. It is true that, as far as my observations go, the larvæ do usually set within a short distance of the old scale, but,

for such an extremely small insect, it can travel fairly fast. I have timed them, when nearly an inch per minute was covered. As a matter of fact, I have found newly set scales 13 inches from the mother insect, and I see no reason why in many cases the distance should not be much greater. One can readily see, therefore, how rapid would be the spread among nursery stock. In stating that the spread, as far as new trees were concerned, was not very marked, it must, of course, be borne in mind how difficult it is—indeed almost impossible—to detect a fresh case where a few isolated scales only are on the tree. Quite recently I saw an English Damson tree some eight years old with one of the upper branches slightly attacked, the fruit also showing scale. This tree was not contiguous to any infested trees, nor were the scales present on the trunk or lower limbs. The scale had evidently been carried by birds or other insects. This sort of thing may exist undetected in many instances, and the following season witness the usual rapid spread of the pest on all such trees. In a favourable season it is probable that four broods would occur in this latitude. They probably commenced breeding here about the middle of June, and although the cold weather of the last day or two has checked any activity on the part of the larva, there are any quantity of them so recently hatched as not yet to have developed the waxy scale. Only this morning I took 15 young ones in various stages of development from the body of one female. Taking June 15 as the date of the first brood's appearance, and assuming 39 days as the time for one generation (in the breeding case here, the time occupied was from 36 to 39 days) the fourth brood would commence emerging on October 10 and under favourable autumn conditions doubtless many of this last brood would develop sufficiently to winter over as half-grown females. I have watched carefully for any sign of the little lady-bird (*Pentilia misella*) which has done such good work on the San José Scale in California and even in the Eastern States, but have failed to see a single specimen. The Twice-stabbed Lady-bird (*Chilocorus bivulnerus*) I have found on infested trees, both in the larval and adult forms, but not in sufficient numbers to render it of any economic importance this season. The food plants upon which I have seen scale in this district are: the pear, the peach, the plum (both of the domestic and Japanese types) and the red currant.

"In conclusion, I may express my belief that the scale is liable to be a serious menace to Canadian horticulture, unless the most stringent measures are adopted to stamp it out of the few orchards where it exists, and the strongest precautions taken to prevent the sale and the planting of infested nursery stock.

"November 20.—I send a few additional notes on the orchard infested by San José Scale near here:—

First saw the trees on July 3. Breeding had probably been going on for some time prior to this; scales of all ages were found and the larva were commencing to set on the young fruit.

July 10.—By this date some of the plums and many of the leaves were almost covered with scales.

July 26.—Some of the badly infested leaves dropping, and fruit and leaves showing marked red discoloration.

October 9.—Frost enough to shrivel a large proportion of the grape foliage.

October 13.—Warm and sunny. Breeding very active. Found from 20 to 30 *Pentilia misella* beetles on one badly infested tree, and over 30 on another. First time of observing these beetles. One *Pentilia* larva also apparently full grown.

Sprayed one badly infested tree with pure kerosene—a good soaking.

October 17.—Hard frost, quarter of an inch of ice.

October 18.—Breeding still active. Sprayed tree, apparently uninjured. Cut bark from four different parts of the tree, and a microscopic examination showed that every scale was dead.

October 28.—Breeding still going on. *Pentilia* beetles and *Chilocorus bivulnerus* both seen. (Have never found more than three or four of the latter on any one tree.)

November 19.—Cold and wet lately. No larva moving and no beetles.

"Now about the spread. These Abundance trees were planted in the spring of 1895. I should infer that at time of planting ten trees were infested, because there were just

ten trees in July the trunks of which were covered with scale. There are 40 or 50 of these Abundance trees together, and next to them on one side is a row of young Beurré D'Anjou pears, and on the other Lombard plums. I have pretty carefully examined the rows of Abundance and these two adjacent rows, and this is what I find at this date, November 19:

60 infested trees (out of a total of 78 in the block) composed as follows:—

10 infested in 1895, now covered and very sickly;

4 less severely, probably attacked last summer or early this spring;

46 slightly, varying from a slight scattering over of the tree to a few scales on a single limb. Every one of the young pear trees is infested slightly, and nine out of the 13 trees in the row the other side of the Abundance block. I have not had time to examine all the trees in the orchard (some 300 or so), but a walk through and a hasty look round revealed one or two trees slightly infested, and I have no doubt a thorough examination would bring to light a good many more cases. The spread, therefore, has been very extensive this year."—[Martin Burrell.]

The Kingsville occurrence of the San José Scale was first reported to me by Mr. Milton G. Bruner, who also kindly showed me, in company with the owner, M. John D. Wigle, the infested spots in the orchards. Mr. Wigle has probably 6,000 trees and there are three centres of infestation, the scale occurring in different orchards, but all comparatively close together. As far as I could judge from a two hours' examination upon an extremely cold day, I should say that there were altogether about 300 trees infested more or less, most of them plum trees, the remainder being dwarf pears. Mr. Wigle is much exercised in this matter and has expressed himself as willing to do anything in his power to prevent the insect from spreading. My thanks are due to him and to Mr. Bruner for assistance in examining his orchards and also for facilities afforded for meeting the fruit growers of Essex County. While with these gentlemen, I had an opportunity of holding two meetings at Olinda and one at Kingsville. These meetings were well attended by leading fruit growers, and the matter of the San José Scale was thoroughly discussed. Mr. Bruner I found had made himself well acquainted with the subject and was able to recognize the species as well as was possible from a superficial examination. He had given much valuable information to those with whom he had been brought in contact in his official capacity as Township Inspector of Black Knot and other orchard pests.

**REMEDIES.**—The remedies other than total destruction of the trees which have been most successfully used towards checking injury by the San José Scale are: (1) Spraying with kerosene emulsion or pure coal oil; (2) washing with whale-oil soap; (3) fumigating with hydrocyanic acid gas; and (4) spraying with the lime-sulphur-and-salt mixture.

When a tree is found to be badly infested, save under very exceptional circumstances, the cheapest plan will be to cut it down at once and burn it. If, however, a tree is only slightly infested or there are special reasons for trying to save it, the tree should be pruned back as closely as it will stand and then washed thoroughly two or three times with whale-oil soap—two pounds of soap in one gallon of water. This is an expensive treatment, but on the whole is the most effective yet discovered.

**1. Kerosene.**—Prof. John B. Smith, of New Brunswick, N.J., Mr. C. L. Marlatt of Washington, D.C., and some other experimenters, have found that a light spraying of pure kerosene oil may be applied to trees without injury, if it be done sparingly, so as only just to cover the bark, and upon a bright day, when the oil will evaporate quickly. I must acknowledge that some limited experiments of my own have not been quite satisfactory. Professor Smith's experiments, however, have been very satisfactory to him, and on 1st of September last, he publicly recommended fruit growers to "spray thoroughly in September all infested bearing apple, pear, plum and peach trees with undiluted kerosene during the middle of a clear sunshiny day. By undiluted kerosene is meant the ordinary burning fluid used in lamps, in exactly the condition in which it is purchased. It should be applied in the finest possible spray, and every part of the plant should be thoroughly wet, but no more."

At the last meeting of the Association of Economic Entomologists held at Detroit, August 12-15, 1897, Mr. Marlatt read some "Notes on Insecticides," in which he speaks

of some experiments in treating several kinds of trees early last spring with pure kerosene. His report is as follows: "Much to my astonishment, no ill effects of any moment resulted in the case of any of the trees sprayed with kerosene. In the case of all the trees, spraying was continued just long enough to moisten the plants thoroughly, but not to cause the oil to run down the trunks and collect about the base, and, with the young trees, the soil was carefully mounded up and pressed about the crown to avoid all danger of the oil collecting at that point." (U. S. Div. of Ent., Bull. 9, N. S.)

In view of these facts, it seems impossible to doubt but that if Prof. Smith's instructions are followed carefully we may have in kerosene (ordinary coal oil), a remedy of great value. At any rate, it is well worth the while of any one who has fruit trees infested with San José or other scale-insects to risk the losing of one or two trees if he can discover a remedy which will save his whole orchard. Care should be taken to mound up some loose soil around the base of the tree treated to catch any superfluous oil. This should be taken away again after the spraying, to prevent the oil from injuring the roots.

2. *Whale-oil soap* is the remedy which I have recommended to my correspondents to be applied, as advised by Dr. Howard, in the dilution of only one gallon of water to two pounds of the soap, the trees to be washed or sprayed with the mixture during the winter, some time after the leaves fall in the autumn, and again the following spring, before the buds open.

One of the chief difficulties with "whale-oil" or fish-oil soaps is the want of uniformity in their composition. It has been found after many experiments at Washington that what is required for spraying purposes is a caustic potash and fish-oil soap which does not contain more than 25 per cent or 30 per cent of water. Mr. Marlatt states that a brand of soap known as "Good's Caustic Potash Soap No. 3" is perhaps the best which has been recently put on the market. This is a soft soap, which is shown by analysis to be a true potash soap, containing about 27 or 28 per cent of water. Soaps made with caustic soda have been found unsuitable for spraying purposes. Mr. Marlatt concludes his account of the Washington experiments up to date as follows:—"Our examination of the soap question up to the present time seems to indicate that we shall have to insist on a potash soap made with a fair quality of fish or Menhadden oil, and that the water should be eliminated by boiling, so as not to exceed at the outside 25 per cent of the weight of soap. Such soap can be used at the rate of 2 or  $2\frac{1}{2}$  lbs. or more to the gallon of water, as a winter wash, without difficulty."

3. *Gas treatment*.—For thorough work in treating infested nursery stock, the fumigation with hydrocyanic acid gas seems in California to have given the best satisfaction. This method, however, is expensive and the materials used are intensely poisonous. However, for large nurseries where many young trees have to be disinfected before being sent out, this is the best method and is very generally adopted by the large American nurseries. \* The plants are placed under a canvas tent made air-tight by painting it twice with linseed oil. The first coat must be quite dry before the second is applied. the size of the tent is immaterial, but it must cover the trees entirely, and its edges should be long enough to lie on the ground, so that the tent may be made perfectly air-tight by having earth thrown upon the edges to prevent the gas from escaping. The latest formula for generating the gas is as follows, for every 100 cubic feet of space to be fumigated:—

Cyanide of potassium (98 per cent)	1 ounce.
Sulphuric acid (66°) ....	1 "
Water.....	2 ounces.

Put the acid and water in an earthenware vessel, large enough to prevent spattering, then place the jar under the tent, add to it the cyanide of potassium and close the opening quickly. The trees should remain exposed to the gas for at least 45 minutes, when it will be found that insects of all kinds have been destroyed. For the fumigation of nursery stock before shipping, many of the large United States nurseries

\*Full details cannot be given here, but will be supplied on application to any one requiring them.

have special buildings in which all trees and shrubs are treated whether known to be infested or not. To save time, these buildings are divided into two compartments, so that one may be emptied while the stock in the other compartment is being disinfected. For treatment of a small number of trees a box may be rendered air tight by pasting paper over all cracks and openings.

4. *Lime-Salt-and-Sulphur Wash* :—This wash is one of the favourite washes on the Pacific coast and has certainly given excellent results in British Columbia. Mr. R. M. Palmer has found it most satisfactory for some years and in his last report refers to it as follows :—“Another year’s experience with the No. 1 spraying mixture (lime, salt and sulphur) has added further evidence of its value as a winter wash for all kinds of fruit trees and bushes. It is generally noted that so much improvement results from its use in the health and vigour of the trees to which it is applied, as alone to justify the cost of the work.”

Mr. Marlatt, when in California, noticed the same good results there in the vicinity of Pomona, Cal., where “unsprayed orchards were badly infested with San José Scale, while in adjoining sprayed orchards the scale was entirely killed and the trees were rapidly recovering and showing vigorous and healthy new growth. In contiguous orchards also of the same kinds of trees which had been cultivated in a similar manner, those trees which had been sprayed yearly were at least one-third larger than the others.”

The mixture which Mr. Palmer has found so valuable is as follows :—

“Lime, unslaked.....	30 pounds.
Sulphur, powdered.....	20 “
Salt, coarse.....	15 “
Water .....	60 gallons.

“Place 10 pounds of lime and 20 pounds of sulphur in a boiler with 20 gallons of water, and boil over a brisk fire for two hours, until the sulphur is thoroughly dissolved. It will then be amber-coloured. Next, place 20 pounds of lime in a cask and pour enough water over it to thoroughly slake it. Add the salt. When dissolved, add to the lime and sulphur, and boil half an hour longer. Add enough water to make 60 gallons. Apply lukewarm. Spray when the trees are dormant, or as soon as the leaves fall, and again in the spring before the buds swell. A good force pump should be used, and care must be taken to cover the infested trees thoroughly with the mixture, which should be constantly stirred when applying.

“To insure freedom from lumps, it is advisable to pass the mixture through a wire sieve or strainer.”—[R. M. Palmer, *Insect Pests and Plant Diseases*, Victoria, B.C., 1897.]

Prof. J. B. Smith also speaks of the good results obtained with this wash on the Pacific coast in his Annual Report for 1896, p. 487 :—“In Yuba and Sutter counties, the lime, sulphur and salt wash is the favourite. The testimony to its efficiency is universal. Few claim that a single spraying is absolutely effective; all contend that two sprayings will kill practically all the scales. Absolutely perfect work cannot be expected, and so there is always a small amount of scale in the orchard; but, as they have found that the use of this wash is beneficial to the trees by seeming to make them more vigorous, less liable to fungus attack and, in the case of peach trees, less susceptible to leaf curl, the spraying is continued every year, whether the scale is abundant or not. A man who does not spray is considered a very poor farmer.”

The above quotations are given for the benefit of British Columbia fruit growers, all of whom are urged to take the fullest advantage of the excellent work which is being done by Mr. R. M. Palmer, Inspector of Fruit Pests. His Annual Reports to the Provincial Board of Horticulture are indispensable to the farmer, fruit grower and gardener, in all parts of the province.

This valuable remedy of the West, however, it must be acknowledged, has not given satisfactory results in the East, Mr. Marlatt even going so far as to say, while acknowledging its value in the West :—“Our experience with the wash in the East had thrown doubt on its real efficiency as an insecticide, and it has been clearly demonstrated that under the climatic conditions east of the Alleghanies it is almost valueless.”

Whatever the reason may be for this great difference, the value of the remedy for the West is undoubted and well attested. Similarly, the gas treatment has given less satisfaction in the East than on the Pacific coast, but this is to some extent due to the difficulty of treating deciduous trees, such as are infested by the San José Scale, which have a more spreading, open growth than the close-growing, thick-foliaged trees of the Citrus family, upon which this method is chiefly used in California for other kinds of scale-insects. For the disinfection, however, of nursery stock, the gas treatment is certainly most convenient. Probably the remedies which will be found most available for Ontario fruit-growers will be the whale-oil soap wash and the kerosene emulsion. The latter should be applied as soon as the leaves drop or during the winter, made according to the Riley-Hubbard formula and diluted with only four parts of water, to be followed before the leaves expand in spring by the whale-oil soap wash, 2 pounds in 1 gallon of water.

Mention may be made of the fact that where trees are closely planted the scale has spread more quickly than where the trees are farther apart. This points to the advantage of having the trees planted as wide apart as possible without waste of land.

Since the San José Scale is already established in several centres in Ontario, it is now too late to prevent its introduction into the country; still, no effort should be relaxed which will prevent further importation from infested nurseries in the United States, and it should not be forgotten that nearly all of the Canadian outbreaks have been traced back to nurseries in the State of New Jersey. There are some precautions which common sense would seem to dictate to all fruit growers, such as: (1) Do not buy either from nurseries known to have been infested, or, as it is unnecessary, even from States where the scale is known to exist. The home-grown trees of all our Canadian nurseries are much safer to purchase than those coming from any of the usual sources in the United States. Up to the present not a single Canadian nursery has been found to be infested.

(2) Examine all trees upon your own grounds and upon your neighbours', particularly those which have been planted or grafted during the last five years.

(3) Plant no young trees without examining them carefully for any trace of the San José Scale. Should any case of infestation, or even suspected plants, be found, at once report the matter and send specimens for examination to the Government entomologists at Ottawa or Guelph for advice.

On account of the exceedingly inconspicuous nature of this enemy and its habit of hiding beneath scales of bark, buds, etc., as well as the extreme danger which attends its introduction, in those cases where it is considered necessary to purchase from American nurseries, it would be well for fruit growers not to trust to the certificates that the trees are free from scale, which are sometimes supplied by nurserymen, unless they are actually signed in writing by state entomologists of recognized standing, and also for the actual consignment of trees with which they are imported.

As an illustration of the difficulty of detecting the young scales when they are few in number, Prof. F. M. Webster has published an illustrated article in the current December number of *Entomological News*, showing a twig from a peach tree which had been submitted to him for inspection and of which he says: "The most diligent search with a lens failed to reveal any outward trace or indication of the presence of San José Scale. When one of the buds was removed it was found that there was behind it a half grown scale which had been completely covered and concealed by the bud." This showed that practically no one could be certain that a tree was absolutely free from scale without removing all the buds, which of course is out of the question.

## THE APIARY.

The practical management of the Apiary, as heretofore, has been satisfactorily carried on by Mr. John Fixter, the Farm Foreman. The interest shown in the Apiary has been very encouraging ; large numbers of visitors have examined it, who have been gratified by the attention shown them and by the explanations given in all matters connected with bee-keeping. One experiment was particularly observed, namely, what has been called the "House Apiary." This is treated of by Mr. Fixter in his report appended hereto. Many of the experiments begun in former seasons have been continued ; but those on wax foundations were not taken up this year. In addition to the explanations given to visitors, two valuable addresses were delivered by Mr. Fixter to the students of the Ottawa Normal School upon the subject of bee-keeping, and he also attended two meetings of Farmers' Institutes, one at Russell Village, Russell County, Ont., and the other at Bell's Corners, Carleton County, Ont., at both of which the directors of the institutes requested that the subject of bee-keeping should be brought up.

The season at Ottawa, with reference to bee-keeping, has been a very remarkable one. Although in June there was a good amount of blossom on flowering plants, bee-keepers in the district were all surprised to find how little honey was stored by their bees.

Notes are being taken, with the dates, of the different kinds of flowers which are attractive to bees, and will be published at some future date. The Breaking Buckthorn, or, as it is more generally known, the Alder Buckthorn (*Rhamnus Frangula*), was noticed to be particularly visited and for a very long period by bees. A supply of the seed of this shrub was, therefore, collected and distributed to all bee-keepers who asked for it before the supply was exhausted.

The condition of the Apiary I consider quite satisfactory, and it is a branch of the Farm work which is growing in popularity from year to year (a fact, it must be stated, almost entirely due to Mr. Fixter's skill and good management).

### RESULTS OF THE WORK OF THE SEASON.

On August 28th all the supers were removed from our hives, when 212 partly filled sections were found. This was all the surplus honey which had been made during the year, and the whole of this was returned to the bees for their winter sustenance. It should also be mentioned that not only has there been an entire lack of surplus honey, but the bees have also failed to swarm, so that the number of colonies was not increased. These results appear the more extraordinary when we consider the large quantities of honey made per colony during the past two years. In 1895 the average was 54 sections per colony, and in 1896 it was 50 sections, besides 16 lbs.  $\frac{1}{2}$  oz. of extracted honey per colony, all having been under the same management and care. There seems to have been an unusual deficiency of nectar in the flowers. The bees worked industriously, but were barely able to accumulate enough for their own subsistence. Indeed it was necessary to supplement their stores with considerable quantities of sugar in order to keep them supplied.

This discouraging condition of affairs prevailed all over the eastern parts of Ontario. In the western parts of that province better results are reported.

The following extracts from letters received will show the peculiarity of the season of 1897, in the Ottawa district :—

"Ottawa, January 7, 1898.—As you are probably aware last season was one of the most peculiar, if not the most peculiar, in the history of bee-keeping in this section of Canada.

"Soon after my bees were removed from winter quarters I noticed that although seemingly working hard every fine day, they were getting little if any honey, and were very rapidly using up the balance of their winter supply. I think I am safe in saying they got nothing from either maple, willow or fruit bloom, that is to say, early fruit bloom such as apple, plum, cherry, currant, &c. After my bees had been out about a week I began feeding systematically every evening, giving perhaps half a cupful to every hive, and by the beginning of May, even with this amount of feeding, they were still drawing heavily on the not very large amount left over from wintering, so much so that by the second week in May scarcely a colony in all my apiary had more than a very little unsealed honey and the hives were absolutely filled with brood, more so than I have ever seen them before, many of the frames having brood in the first row of cells from the top bar of the frame.

"I could not detect any honey being brought in until after the 24th of May, and then only in small quantities from the raspberry bloom. I fed steadily until the 23rd of May, and am quite satisfied that I realized handsomely by doing so. It is perhaps worth mentioning here that in the spring of 1896 all my strong colonies filled the two outside frames so full of honey that I removed them and put empty frames in the hives between the middle frames. The flow was from the willow. Swarming began on the 4th of June, and I have never had finer swarms than during the past season, the great trouble was there appeared to be no end to the swarming season, as I had several swarms in September, as late as the first week, when buckwheat honey was coming in freely.

"I took 45 hives out of winter quarters, having put away 46; the one lost was from dampness, it was touching the outside wall of the cellar. I sold two colonies just before swarming, and by the end of September I had 90 good colonies, most of them very heavy with honey, even the late swarms in September filled up well with buckwheat and goldenrod (*Solidago*) and required very little feeding to bring them up to the 55 pound limit. I sold 25 colonies this fall and have 65 in the cellar now. My total yield of comb honey was a little over 1,100 pounds, of which two-thirds was white clover, basswood and possibly some raspberry mixed, the balance was goldenrod and buckwheat mixed, making a quite agreeable honey.

"I have an idea that the reason of the excessive swarming was partly on account of the honey flow being very intermittent, perhaps two or three days of a heavy flow and then several days with little or none. During the idle days the working force would hang about the hives and amuse themselves building queen cells. Then in a few days out they would come. The total return for the past season by the sale of bees and honey was \$325, less about \$15 for honey fed in the spring."—[Percy H. Selwyn.]

"Almonte, Jan. 12, 1898.—This year I got no white honey. Last year I had between 2,500 and 3,000 pounds. This year's dark honey was about 20 per cent of last year's, and similarly, new swarms were about 20 per cent of last year's. As for feeding, I do not do much of that. Most of my colonies go into winter quarters, heavy with natural stores; but some of the old colonies had none too much, and two or three of the new ones this year did not actually gather enough to winter on."—[J. K. Darling.]

"Chard, Ont., Dec. 27.—I set out 105 colonies on April 23. I had a few colonies set out some days before that. The first pollen was seen coming in on April 22. By July 1, through robbing and starving my colonies were reduced to 70. At the end of the season these were increased to 82. I got 500 lbs. comb honey and 1,500 lbs. extracted, all dark honey. Another bee-keeper here says he began the season with 40 colonies. He had no increase in swarms. He got 50 lbs. comb honey and 860 lbs. extracted, all dark honey."—[W. J. Brown.]

"Bearbrook, Jan. 8, 1898.—I never experienced such a hard spring and summer since I have kept bees. I carried out 22 hives. Four or five were weak, so I united four colonies into two. I ran 4 of my strongest hives for comb-honey and 16 for extracting. The spring was cold and dark, and the summer hot and dry. There was no clover until September, perhaps a little in August; but I never saw such a fall harvest. My bees never did better, even in June and July, than they did for me this year in September off the wild flowers, which grow on the low swampy land along streams. The honey was dark, but of a delicious flavour.—[A. R. McRae.]

## REPORT OF MR. JOHN FIXTER.

## SEASON OF 1897.

April 5.—Hives all taken out of their winter quarters and placed on their summer stands. The bees came out at once and flew well.  
 " 6.—Cloudy, but not cold ; no flying.  
 " 7.—Fine but cool ; flying well.  
 " 8.—Fine, cool toward evening ; bees flying about three hours.  
 " 9.—Dull day ; no flying.  
 " 10.—Warm ; some flying.  
 " 11.—Warm ; bees flying well, some bees attempting to rob ; openings closed to one bee's space.  
 " 13.—Cold and wet ; little flying.  
 " 16.—First pollen gathered from swamp willows.  
 " 17-20.—No flying.  
 " 21.—All bees flying and gathering pollen off different species of willows.  
 " 22.—All flying and working on the flowers of the Siberian squill.  
 " 22-May 11—Working well, gathering pollen.

May 11.—Plum trees and dandelion beginning to bloom. Bees very thick on both.  
 " 13.—Bees working well on wild cherry.  
 " 19.—Cherry and apple trees in bloom, very attractive to bees.  
 " 25.—Bees working on the Siberian pea tree (*Caragana*).

June 1.—Many dead drones and some worker bees were carried out to the entrance of several hives, a most unusual occurrence at this season of the year, a result probably occasioned in some instances by scarcity of new honey. A very close inspection being made, several hives were found to be short of stores and had to be fed, although there were many plants and shrubs at that time blooming.  
 " 9.—The Bush Honeysuckle (*Lonicera Tatarica grandiflora*) came into bloom.  
 " 13.—White clover coming into bloom ; notwithstanding the abundance of bloom, no increase in honey was observed.  
 " 13-15 and later.—Bees working on white clover, alsike clover, Alder Buckthorn (*Rhamnus Frangula*), also raspberries and Mock Orange (*Philadelphus*). All hives fed on syrup, very little new honey having been gathered.  
 " 15-20.—Weather very fine. Bees flying well but no honey appeared to be gathered.  
 " 25.—All flying and working well on white clover and alsike, carrying in some pollen, no surplus honey being stored at this date. Several hives fed with syrup (made by dissolving two parts sugar in one part water, the sugar being added to the water while hot and stirred until dissolved). Bees beginning to improve, showing signs of greater vigour.  
 " 30.—Fine weather ; bees flying freely. Some new honey was stored by the strongest colonies ; it was, however, found necessary to feed some hives.

July 1-6.—Bees working well ; all hives gained rapidly in weight during this period.  
 " 6.—Bees working well.  
 " 11.—Basswood just coming into bloom ; flowers scarce, and, on account of the extreme heat of the weather there was but little gain in weight from this source.  
 " 18.—Bees working on basswood, buckthorn, Catalpa and also on asparagus.  
 " 24.—Bees working on horse beans. Buckwheat in bloom and bees working on it.

Aug. 1.—Buckwheat honey was gathered freely.  
 " 1-28.—The weather was very fine and bees were flying well, but very little surplus honey was stored. All supers were removed ; 212 partly filled sections taken off, which were afterwards returned for winter stores.

## EXPERIMENTS IN WINTERING (1896-97).

*Experiment No. 1.*—Nov. 16, 1896.—Fifteen colonies were put into winter quarters in the cellar and placed on the shelves, beginning eighteen inches from the floor. Under the back end of each hive was placed a three inch block, by which means the back of each hive was raised so as to ensure free ventilation. Each hive was raised from its own bottom board three-eighths of an inch at the back. All front entrances were left wide open, the wooden covers all removed, leaving the propolis quilt on 12 hives and placing a chaff cushion four inches thick on each. On the remaining three hives no propolis quilt was used, but the chaff cushion was laid close to the frames. No difference could be seen between the colonies having on the propolis quilt and those which had none, that is, as to dampness, &c.

Temperature was taken once a week all through the winter:—

	Highest.	Lowest.
November 16 to 30.....	46	40
December .....	44	43
January.....	44	43
February .....	45	43
March .....	46	42
April.....	46	..

The bees were quiet throughout the winter, very slight hum being noticeable.

On April 5 all hives were removed to their summer stands. The temperature was kept regular in the cellar by means of a coal stove and careful watching. The stove was placed in an adjoining room, and was lit when the temperature was low or the cellar damp. The stove and ventilators require a great deal of watching, so as not to allow sudden draughts of warm or cold air, as either disturb the bees too much.

As the advantageous use of the coal stove requires experience, at present I would not recommend it to beginners.

Since the cement floor, shelving and complete ventilation have been put in the cellar, it has given entire satisfaction.

During the past winter every colony in this experiment was perfectly dry and clean and showed no uneasiness of any kind, and all came out in excellent condition.

Average weight of each hive when put into winter quarters was 51 pounds; when taken out on April 5, the average weight was 41 pounds 10 ounces per hive, showing that each hive had lost 9 pounds 6 ounces, which was rather less than the usual amount, owing to the comfortable cellar.

*Experiment No. 2.*—Colonies Nos. 14 and 20 were put into the cellar with tops and bottoms of hives left on, just as they were brought in from the bee-yard. These were to be watched for dampness. During November and December there was a slight hum in both hives, but they were quite dry.

Jan. 11.—Hive No. 14 was damp and noisy; hive No. 20 was dry.

Feb. 1.—Both quite dry, but there were many dead bees at the entrance of hive No. 14.

Feb. 8.—Colony No. 14 very noisy and hive damp; cover removed and ventilation given at bottom by raising the front entrance an additional two inches.

Feb. 22.—Both hives perfectly dry and quiet.

Mar. 1-29.—Hive No. 14 had some spots of faeces on the entrance, and when removed from the cellar on April 5 there was about one inch of dead bees and some mould on the bottom board, but the bees were in fair condition, as the colony was a large one.

April 5.—Hive No. 20 noisy, but dry; very few dead bees on bottom board. Total weight of the two hives when put in, 105 pounds; when taken out, 82 pounds. No. 14 weighed 13 pounds less, hive No. 20, 10 pounds less than when put into winter quarters.

May 24.—Hive No. 14 had 7 frames of bees and  $5\frac{1}{2}$  frames of brood; hive No. 20 had 8 frames of bees and  $6\frac{1}{2}$  frames of brood.

*Experiment No. 3.*—Hives stored in a root-house. Two colonies, Nos. 4 and 6, were kept in a large root-house, which is 100 feet long, 25 feet wide and 10 feet deep. The hives were placed on a shelf nailed up against the side wall, about 3 feet from the ceiling and projecting 2 feet. A curtain was hung from the wall over the top and down in front of the hives, so as to keep out all light. The propolis quilt of hive No. 4 was taken off and a chaff cushion put on in its place. The propolis quilt was left on hive No. 6 and a chaff cushion placed above it. The fronts of both hives were raised an additional half inch to give free ventilation.

Temperature was taken every Monday of each week.

Nov. 3-6.—Bees in both hives quite dry, but making considerable hum.

December.—Temperature of root-house, highest 38, lowest 36; both colonies noisy and quite damp, scarcely any dead bees on bottom of hives.

January.—Temperature of root-house, highest 39, lowest 37; both colonies very noisy, damp and mouldy.

February.—Temperature of root-house, highest 39, lowest 37; both hives quite damp and mouldy. Colony No. 4 showed signs of dysentery.

March.—Temperature, highest 43, lowest 35; both hives showed signs of dysentery; some few bees coming out of both hives; very few dead bees around either.

April 5.—Both hives removed to bee-yard. Both colonies showed signs of dysentery, dampness and mould, but both were very strong in numbers.

Another experiment was also carried on with these two hives; the propolis quilt was left on hive No. 6 between the chaff cushion and the frames. On hive No. 4 no propolis quilt was used, the chaff cushion being placed next to the frames; the object of this was to see if the propolis quilt was liable to hold the moisture in the hives.

After careful watching all the winter, no difference could be noticed.

Weight of hive No. 4 in the autumn of 1896,  $60\frac{1}{2}$  pounds; in the spring of 1897, 45 pounds a loss of  $15\frac{1}{2}$  pounds.

Weight of hive No. 6 in the autumn of 1896, 63 pounds; in the spring of 1897,  $50\frac{1}{2}$  pounds, a loss of  $12\frac{1}{2}$  pounds.

Another examination was made on May 24. Hive No. 4 had 5 frames of bees and 4 frames of brood.

Hive No. 6 had 7 frames of bees and 6 frames of brood, so that they were in excellent condition for a honey flow.

*Experiment No. 4.*—Nov. 16, 1896.—Colonies Nos. 1 and 3 were put into a pit dug in the side of a hill, 3 feet deep by 3 feet in width and 10 feet long, in such a way that the ventilators at both ends might not be immediately above the hives, which were in the middle of the pit. The hives rested on two cedar poles laid the full length of the pit. A third cedar pole of the same length was laid in front of the entrance of the hives, and insured the necessary circulation of the air from the two ventilators one at each end of the pit. These ventilators, which were 3 inches by 4 inches were made of boards, three of which reached down to the bottom of the pit, the fourth only to the top of the pit, and the ventilators rose three feet above the ground. In each hive half inch strips of wood were laid under both sides and under the back end, between the brood chambers and the bottom boards, so as to provide more space at the bottom of the hive in case a quantity of dead bees should accumulate there.

The pit was filled up with loose straw up to four inches from the top, which was made of cedar poles along the length of the pit, the middle ones higher than the others, covered with a layer of straw and one foot of soil. A small shaft was also arranged between the hives, down which a thermometer could be let by means of a string, so that the temperature of the pit could be ascertained. The thermometer was examined once a week. If the temperature rose too much, some of the covering might be removed; and if the contrary, some added. Temperature was taken once each week.

Temperature for November was 42 each time it was taken, and no sound was heard at any time through the shaft or ventilators.

Temperature for the first two weeks of December was 42 ; remainder of month, 39. On December 21, one foot of horse manure was placed over the pit to try and raise the temperature, but no difference was appreciable.

The temperature for February and March was 39, and did not vary one degree during the two months.

The temperature of the pit on April 5, was 40 ; the day being very fine, both colonies were removed to the bee yard.

Hive No. 3, was very damp and mouldy, and had half an inch of dead bees on the bottom board, but no evidence of dysentery.

Hive No. 1 was also very damp and mouldy and the entrance had some evidence of dysentery ; on the bottom board there was about half an inch of dead bees.

Mice had found their way into the pit, but had not been there long enough to do any harm.

The weight of hive No. 1, in the autumn of 1896, was 50 pounds, and in the spring of 1897, 40 pounds, a loss of 10 pounds.

The weight of hive No. 3, in the autumn of 1896, was 52 pounds, and in the spring of 1897, 44 pounds, a loss of only 8 pounds.

May 24, another examination was made as to the strength of the colonies.

No. 1 had 7 frames of bees and 6 frames with brood.

No. 3 had 8 frames of bees and  $6\frac{1}{2}$  frames with brood.

This experiment, therefore, is very satisfactory, and the method is one which can be adopted at small expense by any one who wishes to keep bees. Care must be taken to choose a well drained spot for the location of the pit, and to cover the ventilators with wire netting to keep out mice.

*Experiment No. 5.—Wintering in wood shed (house apiary).*

Two colonies, Nos. 46 and 48 were left in the wood shed with some additional packing as stated in last year's report, page 270.

The wood shed has walls which are double boarded, with an air space of four inches. The floor, which is about one foot from the ground is also double boarded and there is no draught under it. The hives were moved one foot from the wall, and placed on a double thickness of sacks laid on the floor ; the wooden covers were removed and replaced by cushions. In addition to this, the hives were covered above and all round with a double thickness of the same packing. No ventilation was provided for one hive (No. 46) ; for the other, (No. 48), a small shaft half an inch square extended from the opening of the hive to the outside of the shed, and half-inch strips of wood were placed under both sides and under the back, and between the bottom boards and the brood chamber, so as to give more space at the bottom of the hive in case a quantity of dead bees should accumulate.

No flying took place from the time they were packed until they were opened in the spring.

No difference could be noticed as to strength of colonies.

April 5, both hives had two inches of dead bees on the bottom boards and were damp and mouldy, and both colonies were in a very weak condition.

Another examination was made on April 22, when both hives were found to be deserted.

Hive No. 46 weighed in the autumn of 1896, 63 pounds, and in the following spring it weighed 48 pounds, showing a loss of 15 pounds.

Hive No. 48 weighed in the autumn of 1896, 53 pounds, and in the following spring it weighed 37 pounds, a loss of 16 pounds.

*Conclusions.—*The mode of wintering that has given most satisfaction is No. 1.

No. 2. Hives put in the cellar as they came from the bee-yard had not sufficient ventilation. This result agrees with that of last year. During the winter of 1897-98 this experiment is being repeated and also two hives have been stored in the same way except that the wooden covers have been removed, leaving nothing but the propolis quilt.

No. 3. Wintering in a root-house. This experiment was fairly satisfactory, but the hives were too damp. An effort is being made this year to keep the hives drier, by having more ventilation at the bottom.

No. 4. Wintering in a pit out of doors. This experiment was satisfactory, but is being tried this year without filling up the pit with loose straw as was done last year, and two inches of space have been left both at the back and in the front of the hives for better ventilation.

No. 5. Wintering in a closed shed, the hives being merely protected with a double thickness of sacks above and all round them. This experiment was a failure. The cold of winter destroyed most of the bees, very few being alive in spring. The experiment is tried again this winter with the hives placed farther from the outside wall and with more protection against frost.

#### HOUSE APIARY.

An experiment was carried on in a wood-shed, a part of which was partitioned off for that purpose and is now called the House Apiary.

This house apiary opens into a yard that is 30 by 60 feet, surrounded by a close board fence 6 feet high, which gives an excellent shelter from prevailing winds. Both the south and east sides of the shed are covered with grape vines, which seem to keep the building cool during the very hot weather, and the vines are trained so as to leave the entrances perfectly clear. One part of the space in the shed devoted to this purpose faced the south-east and was 7 feet high, 6 feet long and 4 feet wide.

In this portion were placed two tiers of hives; the bottom tier was set on the floor, which is one foot from the ground and double-boarded. The second tier was set on a shelf 3 feet 6 inches from the floor.

Another portion of the shed facing the south-west 7 feet high, 4 feet wide and 32 feet long. There were here 12 hives in one row upon the floor.

From the experience of the past year gained with the part first mentioned, I would recommend two tiers on the south-west side, so that the vacant space might be profitably occupied. The entrances to the hives were 3 feet apart and were cut through the wall of the shed; they were 6 inches by 6 inches, with an alighting board projecting 7 inches by 12 inches wide and sloping so as to throw off rain. The hives are set close to the wall, so as to confine the bees to their own hives.

*Conclusions.*—During the past two summers the colonies in the house apiary, which is surrounded by an inclosed yard, having more shelter from the cold winds of both spring and autumn, were frequently observed to be flying, while the colonies in the exposed open apiary remained in their hives.

Another advantage of this arrangement is that there is less danger of robbing. When the hives are being inspected the examination is obviously more convenient in wet weather, being under shelter; further, if the apartment were made 6 feet wide, instead of 4 feet, and a shelf placed on the wall to hold bee appliances, this would add greatly to its convenience. The alighting board might be made to project only 6 inches and be 10 inches wide.

## GRASSES.

## AWNLESS BROME GRASS

*(Bromus inermis, Leyss.).*

One of the most valuable pieces of work which has been accomplished by the Experimental Farms is the successful introduction into Canadian Agriculture of the Awnless Brome Grass, which, on the whole, has done better than any other introduced grass we have sent out for trial, both for hay and for pasture. The seed of this grass was imported from Russia during the first year of the institution of the Experimental Farms, and it has been grown ever since, with remarkable success. Every year small packages of the seed have been distributed free, in every province of the Dominion to such farmers as have asked for samples, and the reports received from them have been most satisfactory. On the prairies of the West, where, on account of the rapid settlement of the country and of the increase in the numbers of stock, the native grasses are now failing, the Awnless Brome grass is found to be a most useful substitute.

The seed germinates readily and the young plants soon become established. It is a perennial grass with running root-stocks, and is conspicuous for its free leafy growth and tall stems (3 to 5 feet high), which bear an abundance of seed. It flowers at Ottawa in the last week of June or the first week of July. It is very hardy and early, and produces a large crop of hay, which, although rather coarse-looking, is soft, sweet-smelling and palatable to all stock; chemical analysis also shows that it possesses great food value.

Not only does Awnless Brome grass thrive in the rich, moist soil of the eastern provinces, but its growth and productiveness are so wonderful, even in the dry plains of the West, that its cultivation, together with that of the Western Rye-grass (*Agropyrum tenerum*, Vasey),—another most valuable grass, a native of North-western America, which indeed is the well known “Bunch Grass” of the West,—may be said without exaggeration to have solved the problem of fodder production on a large scale in the arid western sections. Under irrigation on the farm of Mr. Wm. Hull, of Calgary, Brome grass has given on 200 acres of land the enormous yield of  $4\frac{1}{2}$  tons of grass per acre. It seems to stand a little more water than Timothy when irrigated. On good lands in the east it produces without irrigation from  $1\frac{1}{2}$  to  $2\frac{1}{2}$  tons of hay per acre.

One notable feature which distinguishes this grass, is that, while most grasses after the flowering period deteriorate rapidly while the seeds ripen, Awnless Brome grass can be left standing till the seeds are fully ripe, and yet the hay crop will be heavier, without being poorer, than if it had been cut when in flower, as should be done generally for all hay grasses in order to get the best value. This remarkable characteristic of Brome grass is due to the fact that after the seed-bearing stem has grown up, a great number of leafy sterile shoots spring up from its base. It is owing to this supplementary growth that the straw, after threshing, still makes hay of excellent quality.

A special value for this grass has lately been discovered, namely, its adaptability for alkaline soil. Mr. Mackay, having tried some experiments, reports as follows:—“Indian Head, Assa., Nov. 12.—The Brome grass on alkaline land, which I referred to in speaking to the Committee on Agriculture while in Ottawa, was grown on two low spots in a field of about 15 acres. The spots are not very large ( $\frac{3}{4}$  acre in both), but, before sowing, the bottoms were white with alkali, though not so bad as low places in other districts. A good many crops had been grown on the field prior to the grass being sown, and no doubt have had some effect on the alkali. It seems to me as if alkali washes out of the soil into low spots, for we find it in varying quantities in places where water stands for a few days and then settles into the soil. Last June we had a deluge of rain, leaving us a 5-acre plot in one of the grain fields covered with water

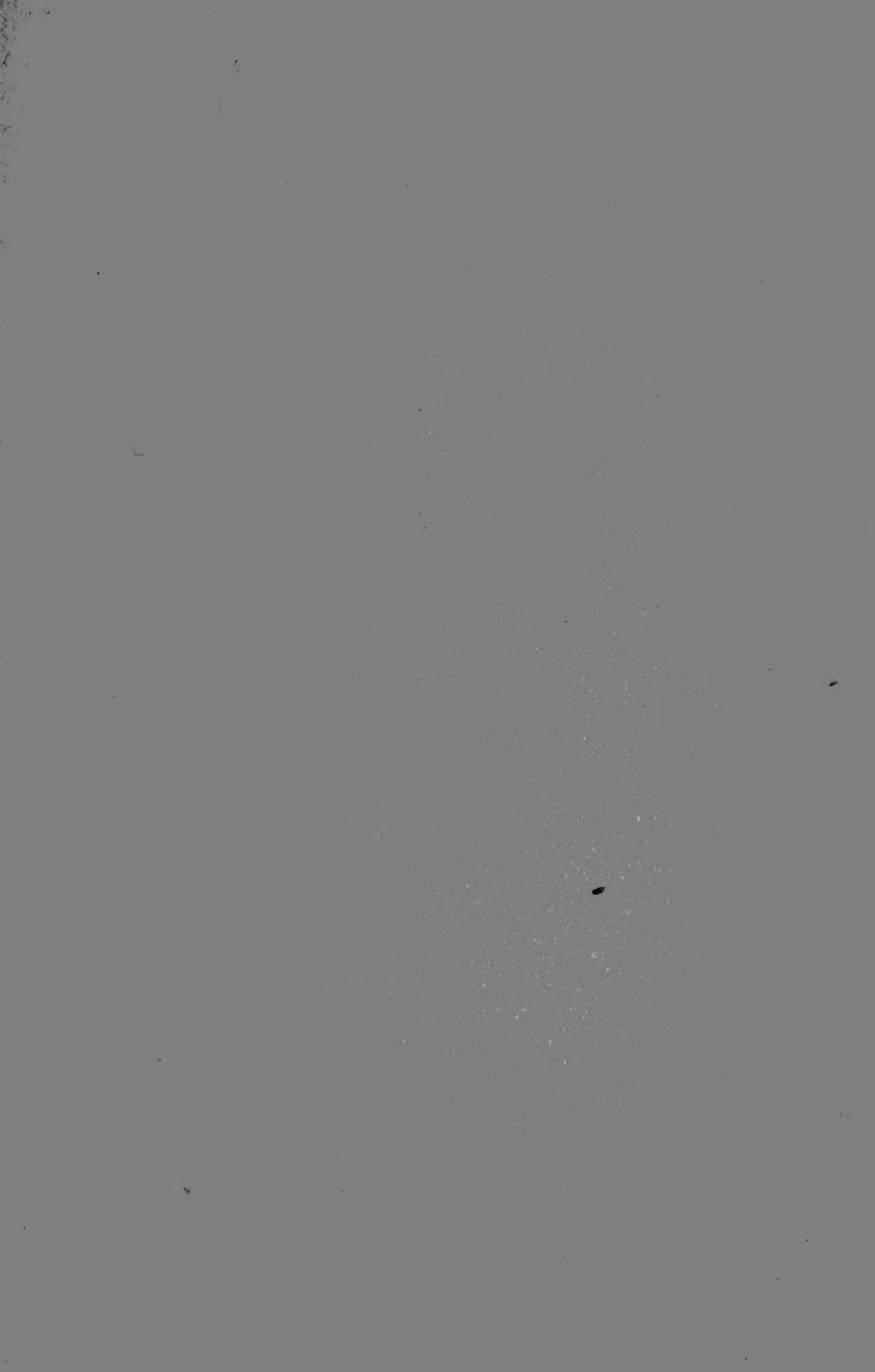
until September. That spot is covered with alkali now, and so far as I know there has been no alkali there before.

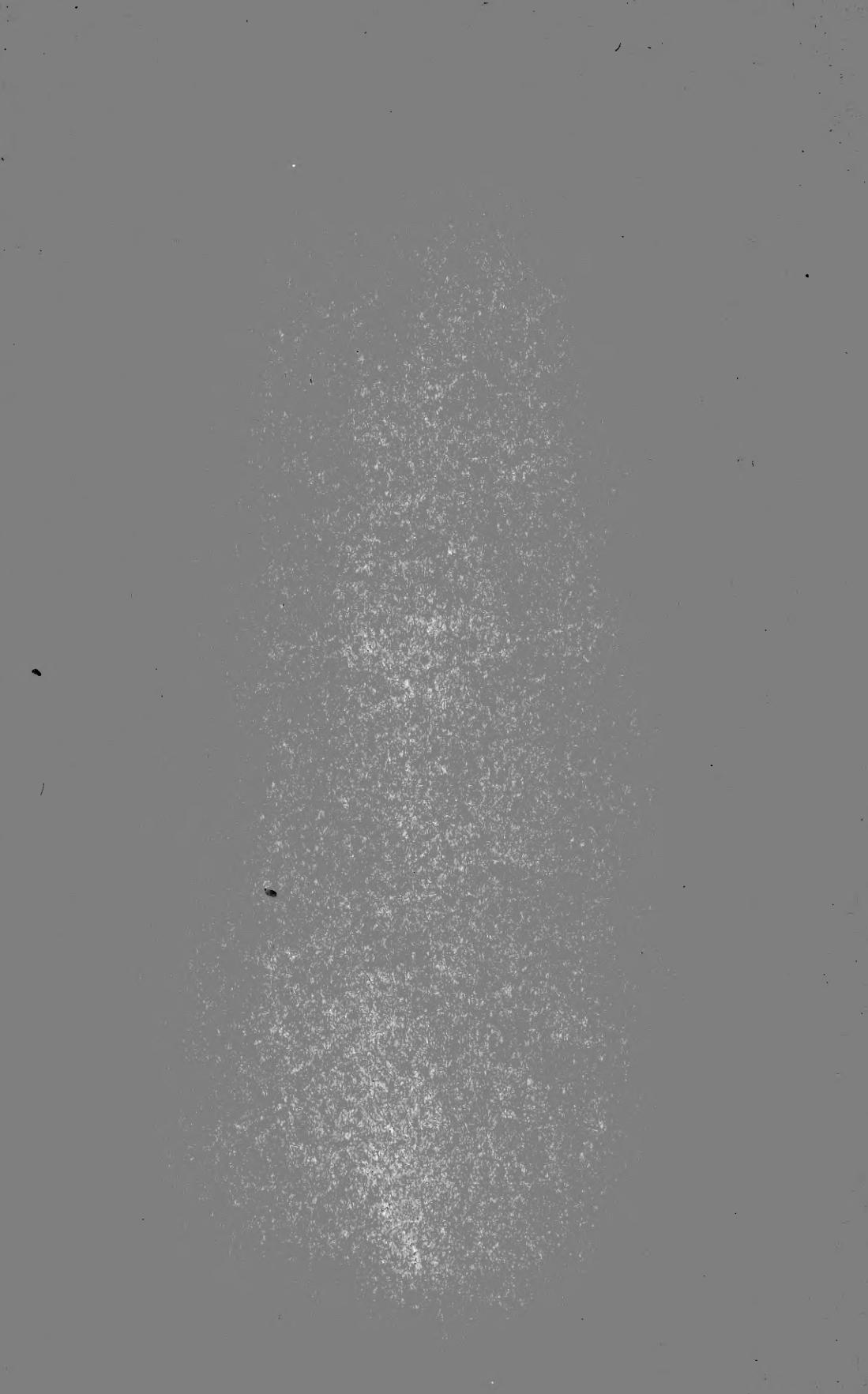
"The crop of hay on the  $\frac{3}{4}$  acre was very heavy, but the land being moist would cause a good crop in any case. Part of this year's crop of Brome hay was grown on low places, upon which alkali is observed every year we plough them; and in these places the crop was very heavy. As no record was taken of the yield on the alkaline spots, I cannot give any exact quantity per acre, but there was at least one-third more hay on them than on the ordinary land."—[Angus McKay.]

"Urquhart, Alta., Nov.—The 1-pound bag of seed received was sown June 11, on 330 square yards of a field which had been sown with grain for the two previous years; but in this particular position little or nothing had grown, the soil being alkaline clay, which is always baked hard in summer. The ground was ploughed in May and well harrowed, and again harrowed previous to the grass being sown, in order to destroy the weeds. The grass grew to a height of 16 inches, but not vigorously over all the ground, some patches being quite bare. It was green and fresh when all the surrounding grass on field and prairie was withered and dead from the early frost. It was not cut. I feel satisfied that it will be a capital grass for hay or pasture, and I intend to sow the whole field (7 acres) with this grass."—[P. McDonald.]

The above quotations suggest a special value in this most excellent grass which was not thought of at the time it was introduced.

In certain parts of British Columbia, the two native species *Bromus Pumpellianus*, Scrib., which closely resembles *B. inermis*, and a large succulent species, *B. brevi-aristatus* Buckl., have been preferred by some growers and further experiments with these species are now being carried on.







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